BATS

of the United States and Canada

MICHAEL J. HARVEY,

J. SCOTT ALTENBACH,

AND TROY L. BEST

VISIT…

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PREFACE

This book is an updated and expanded version of our 1999 booklet "Bats of the United States," published by the Arkansas Game and Fish Commission in cooperation with the Asheville (North Carolina) Field Office of the U.S. Fish and Wildlife Service. Thousands of copies of that publication have been distributed. The primary goal of this (and that) publication is to provide readers with an accurate and concise source of information concerning life histories and conservation needs of this often misunderstood and unappreciated, yet fascinating and highly beneficial, group of animals.

Because all species of bats occurring in Canada (20) also are present in the United States (with 47 species), it was logical to include Canadian bats in this book's title. In fact, information in some of the species accounts was taken from publications by Canadian scientists. Although Canada has less than half the number of species of bats found in the United States, there is a strong interest in biology of bats in Canada, and several Canadian biologists rank among the foremost bat researchers worldwide. Because the 47 species of bats in the United States and Canada account for less than 5% of the species of bats (more than 1,300) worldwide, we have also included some information concerning the biology of bats that occur in other parts of the world.

The combined careers of the authors of this book represent well over a century of research on bats. Dr. Michael J. Harvey, Professor Emeritus and an adjunct professor at Tennessee Technological University, has conducted research on bats primarily in the southeastern and south-central United States. Much of his research has involved ecology and conservation of endangered bats of that region. Dr. J. Scott Altenbach, Professor Emeritus at the University of New Mexico, has concentrated his research primarily on bats of the western United States. He is considered to be a leading expert in the use of abandoned

Blanchard Springs Caverns in the Ozark–St. Francis National Forests, Arkansas, has been developed by the U.S. Forest Service as a tourist attraction. It serves as a hibernation site in winter and a bachelor roost site in summer for large colonies of endangered gray bats (*Myotis grisescens*). *Michael J. Harvey*

mines by bats, as well as in mine safety. In addition to his conservation efforts, he is one of the world's foremost photographers of bats. This book is greatly enhanced by his excellent photographs of all 47 species of bats occurring in the United States and Canada. Dr. Troy L. Best, a professor at Auburn University, has conducted research on bats largely in the southwestern and south-central United States and Mexico. His efforts have focused on ecology and conservation of bats.

Bats in the United States and Canada, as well as worldwide, have suffered significant declines in recent years. In most cases, these declines have been the direct result of activities by humans. We hope this book will help convince the public that we must reverse these declines and thereby preserve this amazing group of animals for the enjoyment and benefit of future generations.

ACKNOWLEDGMENTS

We thank our respective universities (MJH, Tennessee Technological University; JSA, the University of New Mexico; TLB, Auburn University) for aid in making this publication possible. We are especially grateful to Robert R. Currie, U.S. Fish and Wildlife Service, and Keith B. Sutton, Arkansas Game and Fish Commission, for their financial and editorial help in making our 1999 publication possible. We also thank those many colleagues as well as numerous graduate and undergraduate students we have had the privilege of working with during our academic careers.

Because of the general nature of this publication, we have not cited or referenced the numerous authors and publications from which we obtained much of the information presented. To those scientists we owe a deep debt of gratitude. Without the use of the published results of their research, this book would not have been possible.

Finally, our very sincere thanks go to our families for their tolerance, patience, understanding, and support during our numerous nocturnal forays into the world of bats.

Night-vision binoculars and telescopes provide a means of observing bats in almost total darkness. *J. Scott Altenbach*

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BATS OF THE UNITED STATES AND CANADA

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INTRODUCTION

Bats are among the most misunderstood animals in the United States and Canada, as well as worldwide, although as consumers of enormous numbers of insects, they rank among the most beneficial. In other parts of the world, in addition to controlling insects, bats are extremely beneficial in dispersal of seeds and pollination of plants; numerous plants depend entirely on bats for these services.

Bats suffer from a bad public image in much of the world; misconceptions, myths, and superstitions about them abound. They are synonymous with symbols of doom and darkness, are considered to be close associates of Count Dracula, and various parts of their anatomy have been used as magical ingredients in witches' brews ("eye of newt and toe of frog, wool of bat and tongue of dog," *Macbeth*). Many people believe that bats are blind, try to become entangled in human hair, lay eggs, suck blood, are dirty and dangerous, or are flying mice (e.g., *fledermaus,* "flying mouse" in German; *murciélago,* "mouse of the sky" in Spanish; *летучая мышь,* "flying mouse" in Russian). Idioms in various languages underscore the unsavory reputation of bats. They are associated with the netherworld ("like a bat out of hell"). And to describe people as "batty," say they have "bats in the belfry," or refer to someone as an "old bat" is less than complimentary. Books and movies such as *Nightwing* and *Bats* certainly have not helped the image of bats.

In reality, most bats are highly beneficial, intelligent, and extremely interesting. And they have some fascinating traits, such as their homing ability and their ability to navigate by echolocation in complete darkness.

Bats often are associated with the devil, the underworld, and the supernatural. They are considered to have mystical powers. Bats have been used for medicinal purposes, in potions of various types, and they have been used in sacrificial offerings. Indigenous peoples throughout the world, including the Cherokees, Creeks, Navajos, and Apaches, have

Educating people about the importance of bats is a priority in conservation. Many people are unaware of the many benefits provided by bats. *Troy L. Best*

legends about how bats were created. In a Cherokee fable, an eagle, a hawk, and other birds fashioned the first bat from a mouselike animal. Aesop (sixth century BC) was one of the first to feature bats in his writings. Among his well-known fables are two concerning the dual nature of bats (bird or beast?), "The Bats, the Birds, and the Beasts" and "The Bat and the Weasels." Another of Aesop's fables explains why bats are nocturnal. A bat borrowed money, but was unable to pay it back. Fearing to meet his creditors, the bat only ventures out at night.

Bats were considered to be gods by peoples such as the Mayans. The Mayan word for bat is *zotz*. The Mayan bat god was Cama-Zotz (death bat), who lived in a region of darkness through which dying people had to pass on their way to the netherworld. In the highlands of southern Mexico, there are people known as Zotzil (or Tzotzil), "those belonging to the bat." Bats have been depicted in totems, glyphs, talismans, and coats of arms.

Bats are highly regarded in some societies. In China, the word for bat is *fu*; the same word also means happiness or good luck. In Chinese art and handicraft, bats frequently are used to symbolize happiness. A favorite Chinese design is the *wufu*: a disk enclosing the symbol of life (a stylized tree with roots and branches) that is surrounded by five bats with spread wings facing inward. The bats symbolize the fivefold happiness sought by all people—health, wealth, long life, good luck,

The leaf-nosed bat was the symbol of the Mayan city of Copán. This sculpture is in the Copán Museum of Sculpture in Copán Ruinas, Honduras. *Richard C. Finch*

and tranquility. The *wufu* symbol was chosen as the original logo of Bat Conservation International, the world's foremost bat conservation organization. The symbol is part of the new BCI logo.

Unfortunately, far too many people believe that the only good bat is a dead bat. It took many long years to educate people (well, most of them) to the fact that hawks and other birds of prey are beneficial and should not be shot on sight. Hopefully, it will not take so long to educate the public about the true nature of bats and their importance in the ecosystem. Within recent years, numerous publications and organizations have publicized the positive nature of bats. As a result, more and more people are beginning to realize the importance of these denizens of the night and to understand their true nature.

Each year, the North American Symposium on Bat Research is convened at some location in the United States, Canada, or Mexico. Every three years, the International Bat Research Conference is held. In addition, many regional bat-oriented meetings are attended not only by scientists who study bats (chiropterologists) and personnel of state, federal, and provincial conservation agencies, but also by lay naturalists and other individuals interested in bats.

Numerous federal, state, and provincial agencies, as well as several nongovernmental organizations, are very involved in conservation of bats. Among the NGOs are Bat Conservation International,

The *wufu* design with five bats symbolizes happiness. It often appears on Chinese art and handicrafts. *Michael J. Harvey*

Bat Conservation Society of Canada, American Cave Conservation Association, National Speleological Society, the Nature Conservancy, Lubee Bat Conservancy, Organization for Bat Conservation, Basically Bats Wildlife Conservation Society, and Bat World Sanctuary. Bat working groups also have been organized in several regions and states. The primary objectives of these organizations and groups are to help conserve bats and to educate the public about the true nature of bats and their importance in the ecosystem.

During recent years, "bat blitzes" have been held at several locations, most during summer. At these events researchers gather to conduct coordinated, intensive surveys designed to sample the community of bats in a particular area and to study various aspects of their ecology and behavior.

Quarterly publications such as *BATS* and *Bat Research News* keep researchers informed about developments in the "bat world." In addition, most bat-related organizations sponsor websites.

CLASSIFICATION

All bats have both a common name and a scientific designation (species name). Like all animals that have been named and described by scientists, bats are assigned to obligate taxonomic categories: kingdom, phylum, class, order, family, genus, and species. Bats are in the kingdom Animalia, phylum Chordata, class Mammalia, and order Chiroptera. Bats also are assigned to family (one to several genera), genus (one to several species), and species (more than 1,300). The species name is binomial, consisting of the genus and a specific name. Bats may also be placed into additional nonobligate categories such as suborder, superfamily, subfamily, or subspecies (race). A subspecific designation usually is given because of differences in appearance in different regions of the geographic range, but many species have not been divided into subspecies. All taxonomic categories from kingdom through genus are capitalized when written; specific and subspecific names are never capitalized. Genus, species, and subspecies names are italicized.

Hibernating Townsend's big-eared bats (*Corynorhinus townsendii*).
J. Scott Altenbach

The northern long-eared bat (*Myotis septentrionalis*) was formerly considered to be a subspecies of Keen's bat (*Myotis keenii*). *Roger W. Barbour*

Common names of species that have two or more subspecies can be confusing. For example, the common name of *Corynorhinus townsendii* at the species level is Townsend's big-eared bat. At the subspecies level, *Corynorhinus townsendii virginianus* can be called the Virginia big-eared bat; *Corynorhinus townsendii ingens,* the Ozark big-eared bat; and *Corynorhinus townsendii pallescens,* the western big-eared bat. *Corynorhinus townsendii townsendii,* however, is called Townsend's big-eared bat at both the species and subspecies levels.

Here is an example of a complete classification:
(Classification of species and subspecies of the Townsend's big-eared bat in the United States)

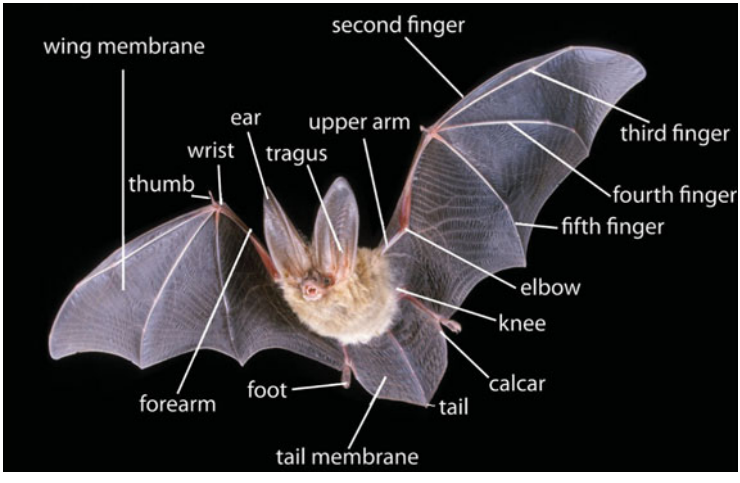
Kingdom Animalia
Phylum Chordata
Subphylum Vertebrata
Class Mammalia
Order Chiroptera
Family Vespertilionidae
Genus *Corynorhinus*
Species *Corynorhinus townsendii*
Common name (Townsend's big-eared bat)
Subspecies *Corynorhinus townsendii virginianus*
Common name (Virginia big-eared bat)
Subspecies *Corynorhinus townsendii ingens*
Common name (Ozark big-eared bat)
Subspecies *Corynorhinus townsendii pallescens*
Common name (western big-eared bat)
Subspecies *Corynorhinus townsendii townsendii*
Common name (Townsend's big-eared bat)

Mexican free-tailed bats (*Tadarida brasiliensis mexicana)* exiting caves form long columns before they disperse to forage. When bats return to these roosts after foraging, they swoop downward so fast that they make a loud buzzing noise as air passes over their bodies. *Michael J. Harvey*

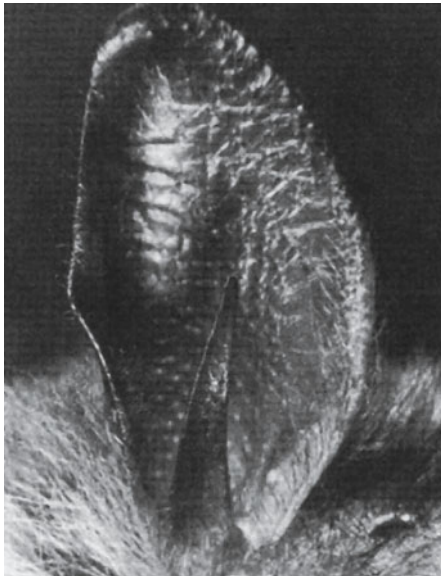
BIOLOGY

Bats, like humans, are mammals: they have hair, give birth to live young, and feed their young on milk from mammary glands of the mother. In southeastern Asia, males of one species of bat (Dayak fruit bat, *Pteropus spadiceus*) actually provide milk for their young. This is the only one of the more than 5,700 species of mammals in which males provide milk.

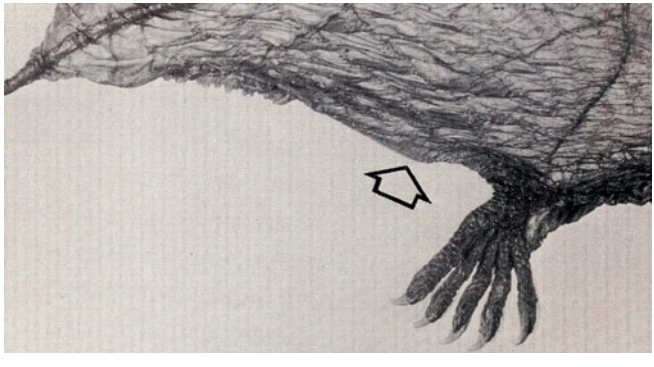
Bats occur worldwide, except for polar regions and some oceanic islands; bats are most abundant in the tropics. There are more than 1,300 species of bats; they are second only to rodents (2,200+ species) in numbers of species among mammals and constitute about one-fifth of all species of mammals. In the United States, there are 47 species of bats, representing 4 families and 19 genera. Canada has 20 species, representing 1 family and 9 genera. Bats inhabiting the United States and Canada make up less than 5% of species of bats worldwide.



Anatomy of a bat, Townsend's big-eared bat (*Corynorhinus townsendii*).
J. Scott Altenbach



Tragus of a northern long-eared bat (*Myotis septentrionalis*). In many species of bats, the tragus in the ear aids in interpreting returning sound waves during echolocation. *Roger W. Barbour*



Calcar of an Indiana bat (*Myotis sodalis*). The presence or absence of a keel on the calcar, a cartilaginous supporting structure that extends from the ankle into the tail membrane of bats, often can be used to differentiate between species. *Roger W. Barbour*

It is likely that the number of known species of bats in the United States and Canada, as well as in the remainder of the world, will increase. Although no "new" bats have been (or are likely to be) discovered in the United States and Canada, the number of species of bats has increased during recent years. This is because what was believed to be a single species, primarily due to similarity in appearance, has been determined to be two distinct species. For example, the species

The western red bat (*Lasiurus blossevillii*), a "tree bat," occurs through much of the western United States and into Canada. Its range extends south through western Mexico and Central America. *Troy L. Best*

formerly known as Keen's bat, *Myotis keenii,* has been determined to be two distinct species, *Myotis keenii,* Keen's bat, and *Myotis septentrionalis,* northern long-eared bat. Worldwide, the number of known species of bats is continuing to increase as new species are discovered and identified.

Many species of bats whose "official" common name does not include the word "bat" can be identified by a name better understood by the general public: for example, the Indiana myotis (*Myotis sodalis*), or Indiana bat. However, care should be taken to ensure that changing the common name to one containing the word "bat" does not duplicate the common name of another species. The northern myotis (*Myotis septentrionalis*), for example, should not be called the northern bat, because there is already a bat whose common name is northern bat (*Eptesicus nilssonii*—found in Scandinavia). Thus, if "bat" is substituted for "myotis," the northern myotis usually is referred to as the northern long-eared bat.

Bats in the United States and Canada can be divided into two major groups, depending on their roosting habits. Cave bats, as the name

implies, inhabit caves (or mines) during at least part of the year; most cave bats hibernate in caves (or mines) and move to trees or man-made structures during summer. Some, like the gray bat, *Myotis grisescens,* occupy caves year-round, although different caves usually are used in summer and winter.

Tree bats seldom enter caves, and most migrate to warmer climates during winter or remain in hollow trees or other sheltered places. Worldwide, bats vary in size from only slightly over 2 grams (0.07 ounce, or about the weight of a dime; hog-nosed bat, *Craseonycteris thonglongyai,* of Thailand in southeastern Asia) to more than 1.5 kilograms (just over 3 pounds; golden-capped fruit bat, *Acerodon jubatus,* of the Philippines in southeastern Asia). The bat with the greatest wingspan is the large flying fox, *Pteropus vampyrus,* of Southeast Asia; wingspan is about 2 meters (6+ feet).

Bats are divided into two suborders, Megachiroptera and Microchiroptera. As the names suggest, megachiropterans generally are larger than microchiropterans. Megachiropterans, which account for about 20% of all species of bats, are distributed throughout the Old World tropics in Africa, Asia, Australia, and islands in the Pacific.

Megachiropterans, such as this large fruit-eating bat (*Epomophorus wahlbergi*), do not occur in the Americas, but they are distributed widely in Africa, Asia, Australia, and islands of the Indian and Pacific oceans. *Troy L. Best*

Worldwide, colors of bats vary greatly. This tree-roosting white bat (*Diclidurus albus*) occurs from southern Mexico to eastern Brazil. *Troy L. Best*

Megachiropterans do not occur in the Americas. The largest bat in the Americas is the spectral bat (sometimes referred to as the American false vampire bat) *Vampyrum spectrum,* which inhabits tropical rain forests from Mexico to Brazil. It has a wingspan of about 80 centimeters (just under 32 inches) and weighs 145–190 grams (5.1–6.7 ounces, or about 1/3 pound), about one-tenth the weight of many of the much larger megabats. Although the genus name of this bat suggests a blood diet, it is not a true vampire bat. It is, however, the world's largest carnivorous bat and consumes a variety of food items, such as amphibians, reptiles, small birds, and small mammals (including other bats). It also eats insects, especially larger species.

Microchiropterans make up the other 80% of bats and are distributed throughout the world. While the large flying foxes of Southeast Asia may weigh more than 1.5 kilograms (3+ pounds) and have a wingspan of up to 2 meters (6+ feet), bats in the United States and Canada vary in size from less than 3 grams (0.1 ounce) to 70 grams (2.5 ounces). The largest bat north of Mexico, the greater bonneted

bat, *Eumops perotis,* occurring from central California southward into Mexico, has a wingspan of about 55 centimeters (22 inches) and weighs 60–70 grams (2.1–2.5 ounces). The smallest bat that occurs in both the United States and Canada is the eastern small-footed bat, *Myotis leibii,* which weighs in at 3–5 grams (about 0.1–0.2 ounce) and has a wingspan of 21–26 centimeters (8-10 inches).

Bats belong to the mammalian order Chiroptera, which means "hand-wing." Bones present in a bat's wing are similar to those of the

This fossilized clawed bat (*Onychonycteris finneyi*) was recovered from the Green River Formation in southwestern Wyoming in 2002. It is from the Eocene Epoch and is about 52.5 million years old. This early bat had well-developed wings and other traits that are present in modern bats. *National Park Service photo of replica FOBU-13514*

human arm and hand, but finger bones of bats are greatly elongated and connected by a double membrane of skin to form the wing. The oldest known fossils of bats, from Wyoming and Europe, date back over 50 million years.

Bats are the only true flying mammals, and their maneuverability while capturing insects on the wing is astonishing. Flight requires a substantial amount of energy; thus, bats must consume copious amounts of food; most eat well over half their body weight nightly. The heart rate of bats varies greatly, depending on if they are at rest or flying. The heart rate of a big brown bat, *Eptesicus fuscus*, for example, is 420–490 beats per minute when not flying; it increases to 950–1,100 beats per minute within 2–4 seconds after flight is initiated. At cessation of flight, heart rate returns to the preflight rate within 10–20 seconds.

Bats are primarily nocturnal, although many can be seen flying early in the evening, sometimes before sunset. Occasionally, especially on warm winter days, they may fly during daylight hours. The only exception to the nocturnal lifestyle among bats is the Samoan flying fox, *Pteropus samoensis,* which occurs on the islands of Samoa and Fiji in the Pacific Ocean. It is the only species of bat known to forage primarily in the daytime. It also soars, much like birds of prey.

ECHOLOCATION

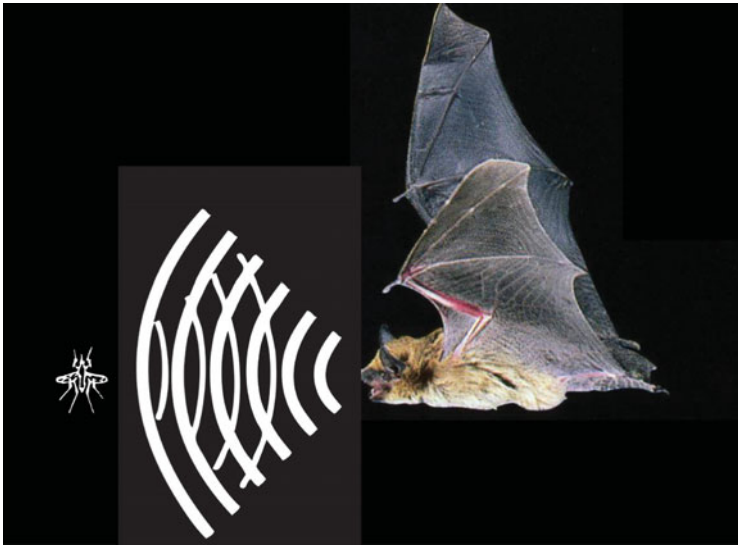
Although bats have relatively good eyesight, most depend on their superbly developed echolocation system (sonar) to navigate and capture insects in the dark. Bats emit pulses of high-frequency sound (usually inaudible to humans) at a rate of a few to 200 per second. Bats can capture tiny flying insects, even in complete darkness. This fantastic ability has been described as "seeing with their ears." Most of the larger fruit bats (flying foxes) lack the ability to echolocate.

Echolocation calls of most bats are in the ultrasonic range (above 20 kHz) and vary upward depending on the species of bat. Echolocation calls of bats hunting prey commonly are classified into three types:

1. "Search-phase" pulses produced by a bat searching for prey. These pulses usually are emitted at a rate of 10–20 per second.
2. "Approach-phase" pulses are developed from search-phase pulses as a potential prey item is detected. During the approach phase, the duration of each pulse and the time between pulses decreases, as does the frequency.
3. During the third or "terminal (feeding-buzz) phase," the pulses continue to decrease in range of frequency and duration until the prey is captured. A little brown bat, *Myotis lucifugus*, can capture up to 500 small (2 mg) insects per hour—one every 7 seconds.

The ultrasonic calls of many bats, if we could hear them, would register well over 100 decibels, which is comparable to noise from a train or large truck. Echolocating bats possess a muscular mechanism that enables them to deafen themselves while they are sending out calls so they will not harm their own sensitive hearing.

Scientists have developed electronic devices (bat detectors) that render ultrasonic calls made by bats audible to humans. Some of these



Bats in the United States and Canada use a highly developed echolocation system (or sonar) to orient themselves and to find and capture prey. Bats increase the rate of calling as they approach prey until calls occur so rapidly that we would hear only a buzzing sound if we were to eavesdrop using a bat detector. *Arkansas Game and Fish Commission*

devices, like the AnaBat Bat Detector, can be used to identify bats to species by producing sonograms of the search phase of their calls, which vary among species.

Evidence suggests that, in addition to navigating and searching for prey, bats also communicate with one another. Bats use a mix of squeaks, chirps, and buzzes to indicate alarm, warning, protest, courtship, territorial defense, and to otherwise communicate with one another.

BENEFITS OF INSECTIVOROUS BATS

Nearly all species of bats in the United States and Canada, and 70% of species worldwide, feed almost exclusively on insects and are thus extremely beneficial to humans. In fact, bats are the only major predators of night-flying insects.

Although bats typically eat more than 50% of their body weight in insects each night, a nursing female may consume enough prey nightly to equal her own body weight, as many as 4,500 or more small insects. Thus, a summer colony of 1,000 bats weighing 10 grams (0.35 ounce) each could consume 10 kilograms (22 pounds) of insects each night, or as many as 4,500,000 insects.

As an example, people in the Chattanooga, Tennessee, area benefit by having over 100,000 kilograms (more than 110 tons) of insects removed from their area yearly by a maternity colony of 100,000 gray bats, *Myotis grisescens*, that spend the summer in a cave near the city. Imagine 220

This small cave in northern Alabama contains one of the largest summer colonies of endangered gray bats (*Myotis grisescens*). Chain-link fencing and signs prohibit passage of people into the cave. On summer evenings, exiting bats often draw large crowds of boating enthusiasts; unfortunately, some people shine spotlights into the cave, stopping the outflow of bats. *Troy L. Best*

half-ton pickup trucks loaded to capacity with insects; that's a whole lot of bugs. Most residents of the area probably are unaware of the presence of their furry flying friends and how they benefit from the bats. Bats serve as natural insecticides throughout the world.

The amount of insects consumed by the hundreds of millions of bats is staggering. The 20 million or more Mexican free-tailed bats, *Tadarida brasiliensis mexicana*, that migrate north from Mexico and raise their young during summer in Bracken Cave near San Antonio, Texas, consume an estimated 182,000 kilograms (more than 400,000 pounds) of insects nightly. Imagine again—400 half-ton pickup trucks filled with insects—*each night*.

The nightly dispersal of more than 100 million Mexican free-tailed bats from caves and bridges in south-central Texas has been observed by National Weather Service NEXRAD Doppler radar. Using the radar data, researchers discovered that the nightly dispersal of bats paralleled the time and spacing of large emergences of the cotton bollworm moth, one of the most destructive insect pests of the southwestern United States and northern Mexico. Mexican free-tailed bats congregate in huge numbers at altitudes between 180 and 1,000 meters (about 590–3,300 feet), and even as high as 3,000 meters (about 9,800 feet), and consume vast numbers of these moths. Mexican free-tailed bats also consume quantities of many other destructive insect pests, such as the corn earworm moth.

Bracken Cave in southern Texas contains one of the largest colonies of bats in the world. At least 20 million Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) migrate from Mexico and Central America to raise their young here in summer. Bat Conservation International purchased this cave to protect the bats. *Troy L. Best*

FORAGING

Some bats forage within about 1–2 kilometers (0.6–1.2 miles) of their day roost, while other species may travel more than 50 kilometers (30 miles) each way in search of food every night. Some of the huge colonies of Mexican free-tailed bats, *Tadarida brasiliensis mexicana,* that leave caves in the southwestern United States each evening in summer are so large that their movements can be tracked by the same radar used to monitor commercial and military aircraft. As they leave their caves, they form "streams" of bats that "flow" over the landscape. These mass exits often begin when the sun is well above the horizon and continue until more than an hour after sunset. Once the stream of bats has moved away from the cave, the bats spread across the landscape in all directions; they forage at altitudes from just above the ground to at least 750 meters (about 2,500 feet), where they consume enormous numbers of extremely destructive insects. Some members of the colony of Mexican free-tailed bats that occupy Carlsbad Cavern in New Mexico during summer forage as much as 56 kilometers (35 miles) from that cave. Using an average foraging area of 41 kilometers (25 miles), researchers calculate that the colony at Carlsbad Cavern forages each night over an area of about 5,300 square kilometers (2,000 square miles).

After foraging, the Mexican free-tailed bats approach the cave opening at high altitudes, fold their wings, and "dive" into the cave. The "buzz" sound created by air moving rapidly over the body of the bat as it dives into the cave is easily heard by humans. The spectacular entrance of the colony into their day roost may last from the middle of the night until after sunrise, depending upon the size of the colony.

Several species of bats exhibit trap-lining behavior. In trap-lining, the same food source is visited and revisited in sequential order. This is a foraging strategy for bees and hummingbirds, which visit a

Pallid bat (*Antrozous pallidus*) with a lined June beetle captured on the wing.
J. Scott Altenbach

flower, go to the next and then the next in sequence before repeating the visits in a similar order. Many kinds of bats appear to use this foraging strategy, whether they are nectar-feeding bats searching for flowering cacti and other desert plants or insectivorous bats searching for insects.

FEEDING BEHAVIOR

While insect-eating bats may often catch flying insects in their mouths, they also capture insects on the wing by scooping them into their tail or wing membranes. The bat then reaches down and takes the insect into its mouth. This results in the erratic flight most people are familiar with when they observe bats feeding in the late evening or around light sources at night. Some bats, like the pallid bat, *Antrozous pallidus,* of the desert southwestern United States,

A few bats in the United States and Canada, such as this pallid bat (*Antrozous pallidus*), land on the ground and forage for insects, other small invertebrates, and even small mammals. *J. Scott Altenbach*

Eastern red bats (*Lasiurus borealis*) often fly during daylight hours, especially on warm days in winter. *J. Scott Altenbach*

land on the ground and forage for insects and other small invertebrates. Others "glean" insects from foliage while flying. Bats drink by skimming close to the surface of a body of water and gulping an occasional mouthful, often much to the dismay of people in and around swimming pools.

A Townsend's big-eared bat (*Corynorhinus townsendii*) skims over a stream and drinks while flying. *J. Scott Altenbach*

NONINSECTIVOROUS BATS

While most species of bats in the United States and Canada are insectivorous, bats in other parts of the world feed on a variety of items in addition to insects. Many species, including the large flying foxes, feed primarily on fruit, while others feed on nectar and pollen. Several types consume leaf material and sap. Much of the fruit consumed by fruit-eating species is overly ripe and thus not a problem for fruit growers. Fruit bats perform an extremely important function as seed dispersers; many plants depend on bats to scatter their seeds.

Lesser long-nosed bats (*Leptonycteris yerbabuenae*) are important pollinators of a variety of plants, including agaves, from which tequila is made. *J. Scott Altenbach*

Mexican long-tongued bats (*Choeronycteris mexicana*) consume fruit, nectar, pollen, and possibly insects. Day roosts often are in shallow caves or rock shelters with ample light. *J. Scott Altenbach*

Lesser long-nosed bats (*Leptonycteris yerbabuenae*) forage at a hummingbird feeder in the Chiricahua Mountains, Arizona. Four species of bats in the United States include nectar in their diet. *Troy L. Best*

Jamaican fruit-eating bats (*Artibeus jamaicensis*) may spend the day hanging from the leaves or bark of a palm tree. *Troy L. Best*

Nectar-eating bats, like bees and many other insects, are important pollinators. Many plants depend almost entirely on bats for pollination. An example of a very close association between a species of bat and a plant is the relationship between the tube-lipped nectar bat, *Anoura fistulata,* and a bellflower plant, *Centropogon nigricans,* in Ecuador. The extremely long flower of this plant is pollinated only by this bat, while the bat feeds on its nectar; the bat extends its 8.5-centimeter (3.3-inch) tongue into the flower to reach the nectar. The bat's tongue is about one and a half times the length of its body; the longest tongue in proportion to body size of any mammal.

A few bats eat fish, which they capture by flying low over the surface of the water and gaffing the fish with their exceptionally sharp claws. A few species eat the flesh of other animals, including mice, birds, frogs, and even other bats. Vampire bats feed exclusively on blood.

The greater bulldog bat (*Noctilio leporinus*) of Mexico, Central America, and South America, a fish-eating species, fishes by skimming over water and gaffing fish with its sharp claws. *J. Scott Altenbach*

VAMPIRE BATS

Most famous (or infamous) among bats are the three species of vampire bats of Mexico, Central America, and South America, which feed on blood of warm-blooded animals. Vampire bats obtain blood by biting their victims with their sharp incisor teeth and then lapping (not sucking) blood as it flows from the wound. The common vampire bat, *Desmodus rotundus,* weighs only about 25–40 grams (0.9–1.4

White-winged vampire bats (*Diaemus youngi*) feed on blood from a chicken. Chickens generally are undisturbed by the bats, which bite the bird in the anal region or lower leg. *J. Scott Altenbach*

The common vampire bat (*Desmodus rotundus*) feeds primarily on blood of mammals, including several domesticated species. Common vampire bats are relatively small, weighing only 25–40 grams (about 1 ounce) and having a wingspan of about 36–37 centimeters (14–15 inches). *J. Scott Altenbach*

ounces) and has a wingspan of about 36–37 centimeters (14–15 inches), although in horror movies they are depicted as being much larger. There is only one record of a vampire bat from the United States. In Texas, several years ago, a hairy-legged vampire bat, *Diphylla ecaudata,* was found in a railroad tunnel. This bat was more than 700 kilometers (435 miles) north of its known range in Mexico. The common vampire bat, the species that feeds on the blood of mammals, has been recorded in Mexico within 200 kilometers (about 125 miles) of the United States. Mexican people refer to the common vampire bat as *murciélago de sangre,* bat of blood. The hairy-legged vampire bat and white-winged vampire bat (*Diaemus youngi*) feed primarily on the blood of birds.

GUANO

Bat droppings or "guano" make excellent fertilizer. Certain caves are mined for this valuable material, and some reportedly once contained thousands of tons of guano until much of it was removed for use as fertilizer. More than 90 million kilograms (100,000 tons) of guano were mined from Carlsbad Cavern in New Mexico in the early 1900s.

During the Civil War, numerous caves in the southeastern United States that were occupied by bats, often referred to as "peter caves,"

Scientists collect guano samples in Sauta Cave National Wildlife Refuge, Alabama, to assess levels of pesticides in remains of prey. *Troy L. Best*

Cave Mountain Cave, Buffalo National River, Arkansas, like many caves in the southeastern United States, was mined for saltpeter by the Confederates during the Civil War. The nitrogen-rich earth and guano were used to manufacture gunpowder. The cave is protected by the National Park Service and serves as a hibernaculum for large numbers of endangered gray bats (*Myotis grisescens*). *Michael J. Harvey*

were mined by the Confederate army for their nitrogen-rich earth and guano. This material was used to produce saltpeter (potassium nitrate) for use in manufacturing gunpowder. Remains of the saltpeter mining operation can be found in caves throughout the region. At a cave in Arkansas that is now on Buffalo National River lands, the Confederate army constructed 14 buildings and several pieces of machinery in 1862. That operation continued until January 10, 1863, when it was captured and destroyed by Union soldiers of the Iowa cavalry.

SUMMER HABITAT

During summer, bats in the United States and Canada occupy a variety of habitats. They may congregate in caves, mines, trees, or man-made structures such as bat houses. They may also roost in buildings or under bridges. Many species segregate into maternity and bachelor colonies. Maternity colonies may be huge. For example, 20 million, mostly female, Mexican free-tailed bats, *Tadarida brasiliensis mexicana,* migrate from Mexico to give birth and raise their young in Bracken Cave in Texas. Other colonies are not so large, ranging from a few to thousands of bats. Some species form relatively small

Sauta Cave National Wildlife Refuge, Alabama, is home to one of the largest summer colonies of the endangered gray bat (*Myotis grisescens*). The chute-type steel gate at the opening allows bats easy access but keeps humans from entering the cave. *Troy L. Best*

This dead hemlock tree in the Nantahala National Forest, North Carolina, was the roost site of the first maternity colony of endangered Indiana bats (*Myotis sodalis*) discovered south of Kentucky. Several species of bats roost under loose bark of dead trees during summer. *Michael J. Harvey*

This abandoned boiler in western North Carolina serves as a summer roost for Rafinesque's big-eared bats (*Corynorhinus rafinesquii*). *Michael J. Harvey*

Abandoned buildings serve as summer roosting sites for several species of bats. *Kentucky Department of Fish and Wildlife Resources*

maternity colonies under exfoliating bark of dead trees, in hollow trees, or in man-made structures. Many other species do not roost in colonies. Males of species that do not congregate in bachelor colonies often roost singly. Some species roost only in the foliage of trees during summer.

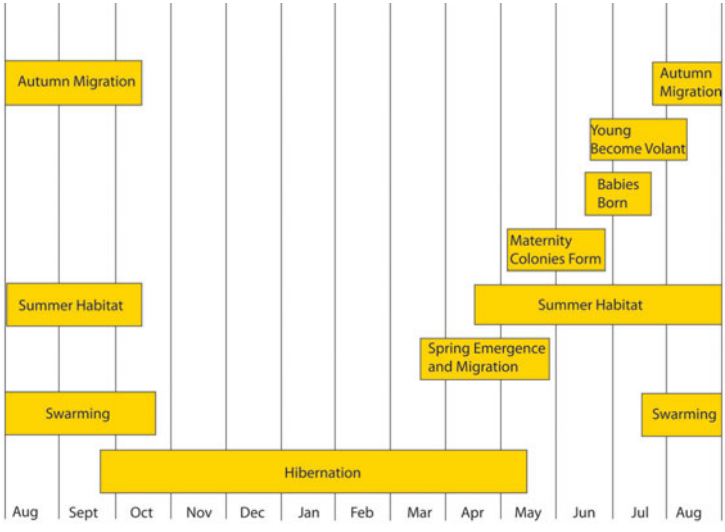
Some bats in other parts of the world construct their own roosts by modifying their natural surroundings. Tent bats bite through veins of large leaves causing the leaf to collapse downward, forming a tent-like structure under which they roost.

The lesser short-tailed bat, *Mystacina tuberculata,* one of only three species of bats native to New Zealand, burrows into leaf-liter and humus on the forest floor searching for food. It may burrow into rotten logs and trees to excavate its own roosts, or it may occupy and forage in burrows made by seabirds. The terrestrial lifestyle of this burrowing bat has made this species particularly vulnerable to introduced predators. The three species of bats in New Zealand are the only endemic species of mammals; all other mammals in New Zealand were introduced by humans.

This brick-covered storm drain in Pittsburg, Kansas, is summer habitat for a maternity colony of endangered gray bats (*Myotis grisescens*). *Michael J. Harvey*

SUMMER–AUTUMN SWARMING

Many species of cave-dwelling bats arrive at their hibernacula in preparation for mating and hibernation as early as late July. Upon arrival, the bats "swarm." During swarming, large numbers of bats fly in, out, and around openings of caves from dusk to dawn, although a few roost in the caves during daytime. Swarming continues for several weeks, usually through at least mid-October, peaking in September and early October. During this time, mating occurs. Swarming at a particular cave opening may involve several species of bats, including non–cave species such as eastern red bats, *Lasiurus borealis.* This behavior may also familiarize young-of-the-year with potential hibernation sites.



Annual chronology of life-history events for the endangered Indiana bat (*Myotis sodalis*). Most cave-dwelling bats in the United States and Canada follow similar annual patterns. *Michael J. Harvey*

Several species of bats, including tree bats such as this eastern red bat (*Lasiurus borealis*), swarm around openings of caves during late summer and early autumn. Mating occurs at this time. Females store sperm during hibernation and fertilization occurs in spring. *Roger W. Barbour*

WINTER HABITAT AND HIBERNATION

Because insects are not available as food during winter, temperate-zone bats survive by either migrating to warmer regions, where insects are available, or by hibernating. Most bats that do not migrate hibernate in caves or abandoned mines. Hibernation is a state of torpor during which normal metabolic activities are greatly reduced. Body temperature in hibernating bats is reduced from more than 42°C (108°F) to that of the hibernation site, usually 4°–15°C (39°–59°F). Heart rate is slowed from over 1,000 beats per minute (bat in flight) to only one beat every 4–5 seconds. A hibernating bat can survive on only a few grams of stored fat during the 5–6 month hibernation period. Bats usually lose 25%–50% of their prehibernation weight during hibernation.

Large clusters of hibernating endangered gray bats (*Myotis grisescens*). About 95% of all gray bats hibernate in about 15 caves. *Michael J. Harvey*

Some species of bats, such as this big brown bat (*Eptesicus fuscus*), usually hibernate singly. *J. Scott Altenbach*

During hibernation, some bats, such as the tri-colored bat (*Perimyotis subflavus*), roost in humid caves and become covered with condensation. *Roger W. Barbour*

Several species of bats hibernate in dense clusters on walls or ceilings of caves. Clusters may consist of 4,000 or more bats per square meter (400 or more bats per square foot), depending on the size of the species. Other species hibernate singly. Species are very restricted in their choice of microclimate conditions of hibernation sites, for example, temperature, humidity, and air flow. Several species overwinter in hollow trees or other protected shelters. Some tree bats, like the eastern red bat, *Lasiurus borealis,* spend winter buried in leaf litter on the forest floor.

MIGRATION

Most cave bats in the United States and Canada spend winter hibernating in caves (or mines) and move to trees or man-made structures during summer. A few species reside in caves year-round. Tree bats seldom enter caves. Most roost in trees in summer and migrate to warmer regions during winter.

Several species of bats make relatively long migration flights between summer and winter habitats. Some silver-haired bats, *Lasionycteris noctivagans,* and hoary bats, *Lasiurus cinereus,* migrate from summer ranges in the western United States and eastern Canada to the southeastern United States in autumn. The millions of Mexican free-tailed bats, *Tadarida brasiliensis mexicana,* that spend summer

Endangered gray bats (*Myotis grisescens*) occupy colder caves in winter and warmer caves in summer. Other caves, like this one on Buffalo National River lands in Arkansas, are used as transient caves during seasonal migrations. *Michael J. Harvey*

Silver-haired bats (*Lasionycteris noctivagans*) that spend summer in western and northern regions of the United States and in southern Canada migrate southward to warmer climates in winter. *Roger W. Barbour*

in caves of the southwestern United States, such as Bracken Cave in Texas and Carlsbad Cavern in New Mexico, migrate up to 1,300 kilometers (800 miles) to and from their winter roosts in Mexico or beyond. Most cave bats return year after year to the same cave, often to the exact location in the cave where they spent the previous winter. How bats orient and navigate over great distances is poorly understood. There is evidence that they use mechanisms similar to what birds use, such as magnetic fields, celestial orientation, or both.

Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) make one of the longest annual migrations by bats, traveling from Mexico and Central America, where they overwinter, to the southwestern United States, where they spend the summer in caves. *Roger W. Barbour*

HOMING ABILITY

Homing ability, defined as the ability to return home after being displaced into unfamiliar territory, has been demonstrated to occur in diverse groups of animals, among them, birds, rodents, turtles, frogs, fish, and bats. The homing ability of pigeons is well known. During the 1950s and 1960s, numerous homing studies were conducted to determine if bats exhibited homing ability. Many species of bats were tested, and most had at least some degree of homing ability.

During a 1960s study of bats' homing ability, 1,472 Indiana bats (*Myotis sodalis*) were captured in this Kentucky cave. They were transported 322 kilometers (200 miles) away, banded, and released in three different locations, one of which was outside their usual geographic range. At least 38% of the bats were able to return to the cave. *Roger W. Barbour*

In a homing study conducted in 1963, Indiana bats, *Myotis sodalis,* were removed from their hibernation cave in northeastern Kentucky during October, shortly after arriving from their summer habitat. Three groups of 472–500 bats were transported to sites 322 kilometers (200 miles) in three different directions from the cave, banded, and released. One hundred were banded as a control and released at the cave opening. Within only a few weeks, 67% of bats released at a site north of the cave were able to find their way back. Nearly 29% returned from a release site southeast of the cave, which was outside the species' normal range and located across the highest mountains in the southern Appalachians. Almost 15% returned from a western release site. Of the control bats, 86% were recovered. Many others from all groups likely returned undetected, because there were numerous inaccessible cracks and crevices in the cave where bats could hide. At the time of this study, it was not known where maternity colonies of Indiana bats were located in summer.

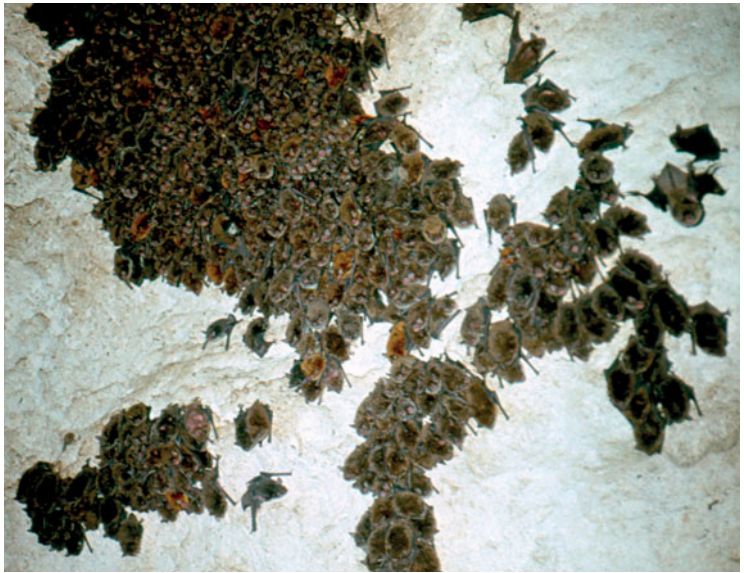
Researchers have determined that bats, like homing pigeons, may use the earth's magnetic fields, celestial cues, or both as aids in homing. Few homing experiments have been conducted on bats in recent years due to concerns about the bats' welfare. Most homing experiments were conducted during the 1950s and 1960s; at that time, bats often were collected in large numbers as specimens by using mist nets, shotguns, or both.

REPRODUCTION AND LONGEVITY

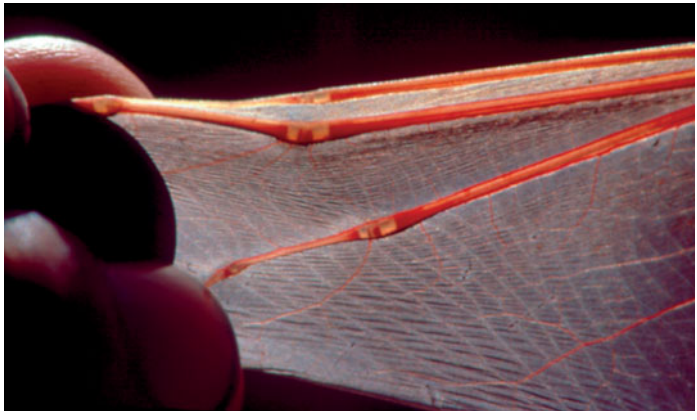
Most female bats in the United States and Canada produce only one offspring per year, although some species give birth to two, three, or four babies at a time. Most breed in autumn, with females storing sperm until the following spring when fertilization takes place (delayed fertilization); other species breed in spring. Gestation lasts only about four weeks, and baby bats are born in May or June. Newborn bats may weigh up to 40% of the weight of their mother, equivalent to a 45-kilogram (100-pound) woman giving birth to an 18-kilogram (40-pound) baby. Baby bats are naked and blind at birth, but develop rapidly; most are able to fly within 4–5 weeks after birth. Males generally have no role in raising the young. Bats live relatively long lives for animals of their small size, some more than 30 years, as evidenced from recoveries of banded bats.

Several species of bats form summer "maternity" colonies of pregnant or nursing females that may congregate and cluster together. The

This maternity colony of the southeastern bat (*Myotis austroriparius*) occupies a cave in southern Alabama. Note the two color phases of bats in this colony. Young bats are usually grayish. *Troy L. Best*



Newborn Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) cluster together in a cave. Mothers do not roost with the babies, but they return to feed them multiple times a day. *J. Scott Altenbach*



Degree of ossification in the wing bones of a bat can be used to differentiate adults from young-of-the-year. Gaps near ends of bones in the wing identify young bats. *Keith Geluso*

combined body heat of bats in maternity colonies of those species that rear their young in caves serves to raise the temperature of colonies to an optimum temperature for development of the young.

Female Mexican free-tailed bats, *Tadarida brasiliensis mexicana,* form huge maternity colonies in several caves in the southwestern United States. The largest of these occupies Bracken Cave in Texas;

This dead pine tree in Great Smoky Mountains National Park, Tennessee, served as a roost for a maternity colony of endangered Indiana bats (*Myotis sodalis*). Bats roosted under loose bark on one of the tree limbs. *Michael J. Harvey*

the colony is estimated to contain about 20 million bats. Females give birth to a single baby but roost separately from their young. In the complete darkness of the cave, clusters of baby bats cover thousands of square meters of ceiling. Mother bats visit the clusters of babies twice daily to nurse them. At one time, it was believed that a mother could not locate her own baby and that communal nursing occurred. But researchers have learned that most of the time (at least 85%), a mother finds and nurses her own baby. She does this by using echolocation to return to the place where she last visited her baby. Then by using a combination of voice recognition and sense of smell, she locates her own offspring among the millions of baby bats.

Bats inhabiting tropical areas of the world are less restricted to seasonal reproduction than those in temperate zones, and females may give birth two or even three times per year. Reproductive events in the tropics may be related to cycles associated with onset of dry and wet seasons that effect production of flowers and fruits by plants, which may influence populations of insects and other sources of food for bats.

Although males and females of species in the United States and Canada may come into contact only for mating, several species of bats in other parts of the world form "harems" consisting of a single male and several females. Some harems are maintained for at least three years. Males of most harem-forming species defend their females from other males.

BATS AS FOOD

In some locations, especially parts of Asia and Africa and islands in the Pacific, many species, particularly the large fruit bats, are used as food by humans. For example, on the island of Guam, many native people consider Mariana fruit bats (*Pteropus mariannus*) to be a delicacy. Prior to government regulations to protect the bats from overharvesting, people sometimes paid exorbitant prices for a fruit bat dinner. *The New York Times Natural Foods Cookbook* (1972), contains a recipe for "fruit bat soup." It calls for boiling three large whole fruit bats in water with ginger, onion, and salt. The bats are then skinned, meat is removed from the bones, and skin and bones are discarded. The meat, broth, and any desired viscera are then sprinkled with scallions and seasoned with soy sauce, coconut cream, or both. Enjoy!

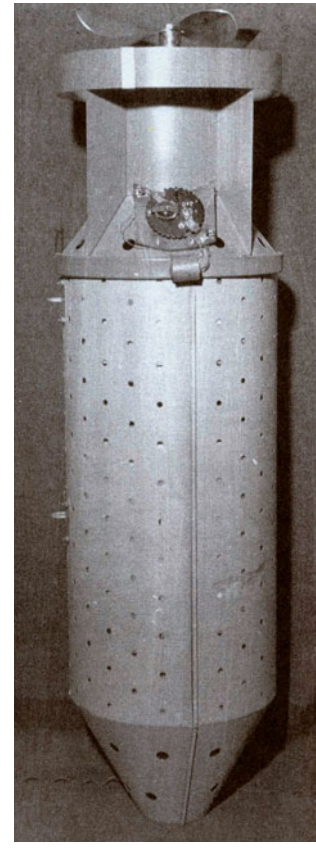
Although the relatively small bats in the United States and Canada generally are not used as food, smaller bats are consumed in other parts of the world. Conservationists are concerned that many species of bats may become extinct due to overharvest and inadequate management. This is true, not only for the larger "meatier" species but also for many smaller bats.

Large fruit-eating bats are hunted for food in many parts of the world. Smaller bats also are eaten by some indigenous peoples. The very large fruit-eating bats (Megachiroptera) do not occur in the Americas, but smaller fruit-eating species occur widely in Central and South America. *Roger W. Barbour*

BAT "BOMBS"

One of the most interesting stories about bats concerns a plan to use them as weapons during World War II. Project X-Ray, conceived by Lytle S. Adams, a Pennsylvania dental surgeon, was to be carried out by the U.S. Navy. The plan entailed using thousands of Mexican free-tailed bats, *Tadarida brasiliensis mexicana*. Each bat was to carry a small incendiary bomb equipped with a chemical timer. The bomb-carrying bats would be dropped by parachute in bomblike containers (1,040 bats per bomb) over Japanese cities. Automatic devices would open the bombs and release the bats before they reached the ground. The bats would disperse into buildings and the incendiary devices would ignite, starting numerous fires that would result in widespread destruction.

Although planning and testing were carried out over a two-year period, the plan ultimately was abandoned, probably because of the development of the atomic bomb. The scheme might have been very effective, as evidenced by the fact that during one of the "bat war games" tests, several buildings at the military base where tests were being conducted were accidentally destroyed by "bat bombs."



During World War II, Project X-Ray tested the feasibility of a bomblike canister filled with bats as a weapon. Each "bomb" would carry 1,040 Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) equipped with incendiary devices and housed in separate compartments of the canister. *U.S. Navy*

MINES AND BRIDGES

Bats often occupy abandoned mines where they raise their young during summer and hibernate in winter. Many of the largest remaining populations of bats in the United States and Canada roost in mines. Many bats use areas beneath bridges and joints between structural components of bridges as sites for maternity and day roosts. The Congress Avenue Bridge over the Colorado River in downtown Austin, Texas, serves as a maternity roost for a colony of Mexican free-tailed

A scientist is lowered into an abandoned mine to inventory the number and the kinds of bats roosting there. Openings of many abandoned mines have gates to prevent entry by humans but allow bats access to roosting sites.
J. Scott Altenbach

Researchers prepare to enter an abandoned copper mine in western North Carolina to check the status of Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) that roost there during summer. *Michael J. Harvey*

Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) exit from under the Congress Avenue Bridge in downtown Austin, Texas. More than 1.5 million bats roost there in summer. *Michael J. Harvey*

Eastern small-footed bat (*Myotis leibii*). These small bats often roost in cracks on cliff faces during summer and in crevices and under piles of rocky debris in caves during winter. *Michael J. Harvey*

Summer roosting site of eastern small-footed bats (*Myotis leibii*). During summer as many as 35 of these small bats roost in joints of this bridge near the Tennessee–North Carolina state line. Most bats using the bridge roost singly. A dime shows the width of this roost site. *Michael J. Harvey*

bats, *Tadarida brasiliensis mexicana,* numbering over 1.5 million individuals. The nightly emergence has become a significant tourist attraction. People line the bridge, observe from the shore below, or board excursion boats to watch the bats leave the bridge to forage.

Thanks to cooperative efforts between conservation organizations, private companies, and government agencies, mines that would have been permanently sealed are being closed with bat-friendly gates to allow bats to inhabit the mines but prevent humans from entering these potentially dangerous sites. An abandoned iron mine in Wisconsin, for example, now houses a winter hibernating population of between 300,000 and 500,000 bats. Efforts are also being made to add bat-friendly features to bridges and other man-made structures.

CONTROLLING "NUISANCE" BATS

The news media are often guilty of sensationalizing stories about rabid bats or colonies of bats in buildings and exaggerating the dangers involved. Even some well-respected magazines have published ridiculous bat-scare stories. One such article, "The Nightmare House," described the experiences of a family that didn't know "there was another presence in the house 'strange and ominous' that was soon to shatter the quiet and suddenly plunge them into terror." A few unscrupulous pest-control companies have charged exorbitant fees for removing (killing) colonies of bats from the homes of "terrified" people.

It is true that a few species of bats in the United States and Canada, given the opportunity, may take up residence in attics or other parts of

Oily stains may indicate that bats are roosting in a building. Here, a net attached to the ventilation panel allows a colony of big brown bats (*Eptesicus fuscus*) to exit, but not to return. Exclusion should be done only when no bats are present in the roost. *Troy L. Best*

buildings, and most people prefer not to have "bats in their belfry" or anywhere else in their residences. The best method of preventing bats from roosting in houses or other buildings is simply to close the openings through which they enter. Bats do not gnaw their way into buildings, as some people believe. Bat-proofing should be done during the time of year when bats are not present (usually September through March) or at night after bats leave to forage. Care must be taken not to trap flightless young in buildings.

Chemical toxicants are rarely a good solution to "bat problems" in buildings. In fact, they may create far worse problems because the poisons may be dangerous to humans or cause poisoned bats to fall to the ground where they die slowly and are more likely to come into contact with children and pets. In addition, bat-proofing procedures often result in energy conservation.

This university administration building serves as a summer roost for a colony of big brown bats (*Eptesicus fuscus*). Many species of bats inhabit buildings during summer and some occupy buildings during winter. Because bats, unlike rodents, do not gnaw, they can be excluded from buildings simply by closing the openings through which they enter. *Michael J. Harvey*

ATTRACTING BATS

Several attempts have been made to attract bats to large wooden "municipal bat roosts." One such roost was constructed in 1918 near San Antonio, Texas. This "bat tower" was designed by Charles A. R. Campbell, a physician in San Antonio, Texas. He hoped that bats would occupy the structure and eradicate mosquitoes and thus malaria, as well as supply guano for fertilizer. But relatively few bats used the structure. Similar structures have been built more recently elsewhere and many have successfully attracted bats. A large bat house on the campus of the University of Florida in Gainesville houses a colony of Brazilian free-tailed bats, *Tadarida brasiliensis,* estimated to number more than 60,000.

As people discover that bats are beneficial and not dangerous, more and more attempts are being made to attract bats, in much the way people try to attract certain songbirds. Many people have placed bat houses in their yards to take advantage of the insect-eating habits of bats.

This large bat house at the University of Florida is home to thousands of Brazilian free-tailed bats (*Tadarida brasiliensis*). Other species of bats also occupy the structure. *Troy L. Best*

This Campbell bat tower in Comfort, Texas, was constructed in 1918 by Albert Steves. It was designed by Charles A. R. Campbell, a physician in San Antonio, Texas, to attract bats and to combat malaria-causing mosquitoes. The structure was restored in the late 1980s. *Richard C. Finch*

Small "rocket box" style of bat house. Many people place bat houses in their yards to attract insect-eating bats. *Michael J. Harvey*

THREATS TO BATS

In the United States and Canada, several animals, including owls, hawks, raccoons, skunks, feral cats, and snakes prey on bats. But relatively few animals consume bats as a regular part of their diet. Humans seem to be the only animal having a significant impact on populations of bats. Adverse impacts from humans include habitat destruction, direct killing, vandalism, disturbance of hibernating and maternity colonies, and use of pesticides (on their food, i.e., insects) and other chemical toxicants. Drastic reductions in populations of bats have occurred during recent years in the United States, Canada, and worldwide. In other parts of the world, there are animals that specialize on bats as food, for example, the bat hawk, *Macheiramphus alcinus,* found in sub-Saharan Africa and in southern Asia to New Guinea.

A Trans-Pecos rat snake feeding on a Brazilian free-tailed bat (*Tadarida brasiliensis*). Snakes often visit openings of caves to eat bats. Gates across openings, constructed to protect bats from disturbance by humans, often facilitate capture of bats by snakes. *J. Scott Altenbach*

Hubbard's Cave, owned by the Nature Conservancy of Tennessee, serves as a hibernation roost for over half a million endangered gray bats (*Myotis grisescens*), as well as six other species of bats. The cave was gated in 1985 to protect its bats. In 2006, the Conservancy replaced that gate with the state-of-the-art cave gate shown here. *Nature Conservancy photo by Cory Holliday*

This chute-type gate at the entrance to Tumbling Creek Cave at the Ozark Underground Laboratory in Missouri was constructed to protect a large maternity colony of endangered gray bats (*Myotis grisescens*) from disturbance by humans. *Michael J. Harvey*

Disturbance to hibernation and maternity colonies by humans is a significant factor in the decline of many species of bats. Even well-meaning individuals such as spelunkers and biologists cause these disturbances. Hibernating bats arouse from hibernation when disturbed by people entering their caves. When aroused, they use up precious fat needed to support them until insects are again available in spring. A single arousal probably costs a bat as much energy as it would normally expend in 2–3 weeks of hibernation. Thus, if aroused often, hibernating bats may starve to death before spring.

Disturbance to summer maternity colonies is also extremely detrimental. Maternity colonies cannot tolerate disturbance, especially when flightless newborn young are present. Baby bats may be dropped to their deaths or abandoned by panicked mothers if disturbance occurs during this period.

RABIES

Bats, like many other mammals, can contract and transmit the deadly rabies virus as well as other diseases. Although rabies has been detected at one time or another in many species of bats in the United States and Canada, it is relatively uncommon. However, reports of rabid bats often make the headlines. Fear of rabid bats is widespread, but even rabid bats are seldom aggressive. On average in the United States between 1995 and 2010, fewer than 2 people per year died from rabies associated with bats. Fewer than 60 people in the United States and Canada are known to have contracted rabies from bats. In fact, rabies was not known to occur in bats until the 1950s. Far more people are killed by dog attacks (15-20 annually in the United States). According to the U.S. Centers for Disease Control and Prevention, each year around 800,000 Americans seek medical attention for dog bites and over 385,000 of those require treatment in an emergency department. Bee stings, power mowers, and lightning kill far more people than rabies from bats. But bats can carry and transmit rabies, and they should not be handled. This is especially true for bats found on the ground, because these bats may be unhealthy.

Individuals who handle bats or other mammals should obtain preexposure immunization for rabies. The vaccination, which is relatively painless, consists of three shots in the upper arm, administered over a period of 21 days. Anyone bitten or exposed to saliva or nervous tissue from a suspected rabid animal should immediately obtain postexposure vaccination.

HISTOPLASMOSIS

Histoplasmosis is a fungal infection that, in humans, primarily affects the lungs, but other organs may also be affected. The fungus that causes this disease, *Histoplasma capsulatum,* occurs throughout the world, where it grows in soil and in deposits of bat guano, in poultry-house litter, and in droppings beneath roosts used by birds. When contaminated soil or droppings are disturbed, spores become airborne and can be breathed into the lungs, leading to infection. Of all reported cases in humans, 90% are from the Ohio and Mississippi river valleys, where warm and humid weather conditions favor fungal growth. Most cases result in flu-like symptoms, although some individuals may become seriously ill. If untreated, histoplasmosis can be fatal. The disease is rare or nonexistent in most of Canada and in the far northern and western United States. When removing guano from attics, walls, or elsewhere, people should wear appropriate clothing and use a high-quality respirator to keep fungal spores from entering the body. Histoplasmosis is not transmitted between people.

BATS AND WIND POWER

Wind turbines are an effective means of increasing energy production and cause significantly less damage to our environment than conventional methods such as strip mining, oil and gas extraction, and damming rivers for hydroelectric plants.

Towers supporting turbines are typically 60–90 meters (200–300 feet) tall. Most support turbines with three blades that are 20–40 meters (65–130 feet) long. Blades rotate up to 25 times per minute, and the speed at blade tips may exceed 320 kilometers (200 miles) per hour.

Wind turbines are responsible for considerable mortality in bats, as well as birds. Estimates of how many bats are killed each year by wind turbines vary from a few to thousands. Not surprisingly, migratory species of bats seem to be killed most often. Most deaths occur in late summer and autumn, the time when bats migrate to overwintering locations. Interestingly, a similar peak in number of deaths does *not* occur during spring migration, and deaths associated with wind turbines are also low for resident and nonmigratory bats. Apparently, relatively few turbine-related deaths are caused by collision with the turbine's moving blades; many dead bats have no external indication of trauma from such collisions. The sudden drop in air pressure next to the moving blades appears to cause severe lung damage (known as barotrauma) to bats that are near the blades, and this causes internal hemorrhaging and death. Many questions remain to be answered about reasons for high mortality to certain groups of bats and what can be done to reduce mortalities due to wind farms.

Wind turbines provide a source of renewable energy but can be hazardous to bats and birds. *Troy L. Best*

WHITE-NOSE SYNDROME

Between 2006 and 2010, well over a million bats died in the eastern United States and Canada from a mysterious ailment called white-nose syndrome, first reported from a cave in New York in February 2006. At least eight species of bats that hibernate in caves have been infected, with more likely to be infected. The disease has spread rapidly across the eastern United States and into Canada; it was reported from as far west as Oklahoma during 2010. A white fungus, *Geomyces destructans,* grows on the bat's muzzle or other parts of the body.

Testing by numerous state and federal laboratories has failed to determine the cause of the infection. Bats have been found dead, presumably due to white-nose syndrome, during winter in hibernacula and at several colonies in summer. Infected bats apparently wake from hibernation more often than uninfected ones. This results in greater than normal loss of weight and bats starve to death before their food supply (insects) becomes available in spring. Mortality rates of nearly 100% have been reported from some hibernacula. It is likely that bats are transmitting the disease among themselves, but people may also be transmitting it from colony to colony. Researchers are following strict protocols to prevent transmitting the disease from one colony of bats to another. Federal agencies such as the U.S. Forest Service have closed caves to humans to help prevent the spread of this disease.

It has been estimated that a million small bats would consume nearly 6,364 kilograms (700 tons) of insects during a single summer. Because bats are the only major predator of night-flying insects, their loss would have a devastating effect on human populations. Many of these insects damage crops or transmit diseases. In 2010, the U.S. Congress, recognizing that bats play a vital role in our ecosystem, approved $1.9 million in research funding to identify the cause of white-nose syndrome and to seek solutions.

Little brown bat (*Myotis lucifugus*) with white-nose syndrome. Since 2006, this fungal disease, first discovered in New York state, has devastated hibernating populations of bats throughout much of the eastern United States and Canada. Millions of bats have been killed by this disease. *Greg Turner, Pennsylvania Game Commission*

CONSERVATION

Numerous federal, state, provincial, and nongovernmental organizations are engaged in the bat conservation effort. Many private landowners and other individuals also are involved. The U.S. Fish and Wildlife Service, Canadian Wildlife Service, as well as other federal, state, and provincial agencies and organizations consider several species of bats to be "endangered" or "threatened." Endangered is defined as being "in danger of extinction throughout all or a significant portion of their range." Threatened is defined as "likely to become endangered in the near future throughout all or a significant portion of their range." Other species are listed in lesser categories such as "special concern" or "in need of management."

Teams of experts established by the U.S. Fish and Wildlife Service and Canadian Wildlife Service have prepared recovery plans, recovery strategies, and status reports for bats in peril. Many protective management measures have been taken, such as gating or fencing certain caves and posting signs at other caves to minimize disturbance of bat colonies by humans. Informational signs tell what endangered species of bats inhabit the cave and when they are present, describe the beneficial nature of bats, and explain the adverse effects of disturbing colonies of bats. Signs also point out that entering these caves during restricted times is illegal; for example, violation of the U.S. Endangered Species Act is punishable by fines of up to $100,000 for each violation.

How you can help with bat conservation:

1. Avoid maternity colonies and hibernating bats. Even a slight disturbance is harmful to bats.

2. Cave habitats are fragile and easily disturbed. If you must enter caves, do so only as an observer. Leave everything as you found it. Also,

BLOWING WIND CAVE NATIONAL WILDLIFE REFUGE
BAT SANCTUARY
* UNAUTHORIZED ENTRY PROHIBITED.
* THIS IS A MATERNITY CAVE USED BY 250,000 PLUS GRAY BATS, AN ENDANGERED SPECIES.
* THIS COLONY OF BATS BENEFITS MANKIND BY CONSUMING A BILLION INSECTS EACH NIGHT.
* A SINGLE ILL-TIMED DISTURBANCE OF THIS COLONY MAY KILL THOUSANDS OF YOUNG BATS.
* BATS EMERGE FROM THE LOWER ENTRANCE NIGHTLY AT DUSK FROM APRIIL TO SEPTEMBER. ESPECIALLY IMPRESSIVE JULY AND AUGUST.
* FINES FOR UNAUTHORIZED ENTRY OR MOLESTATION RANGE UP TO $100,000 AND/OR 1 YEAR IMPRISONMENT.
* FOR FURTHER INFORMATION CONTACT: WHEELER NATIONAL WILDLIFE REFUGE - DECATUR, ALABAMA.
SIGN PROVIDED THROUGH THE ASSISTANCE OF:
THE CENTRAL ALABAMA GROTTO OF THE NATIONAL SPELEOLOGICAL SOCIETY.

Gated openings and informative signs outside caves that are critical habitats for bats apprise visitors that endangered species dwell within. But vandals may cut through gates to gain entry. *Troy L. Best*

remember that disturbing or harming endangered bats is a federal offense carrying serious penalties.

3. Never shoot, poison, or otherwise harm bats. Bats are extremely beneficial insect eaters, and nuisance bats can be encouraged to move elsewhere without injuring them.

STATUS OF BATS IN THE UNITED STATES AND CANADA

Of the 47 species of bats in the United States and Canada, 6 are wholly (species and subspecies) or partially (certain subspecies) considered endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act of 1973. The Canadian Wildlife Service and the Committee on the Status of Endangered Wildlife in Canada list one species of bat as threatened and one as special concern under the Species at Risk Act of 2003. For two species in Canada, the Committee on the

The pallid bat (*Antrozous pallidus*) is the only Canadian bat listed as endangered or threatened. It is threatened in Canada. In the United States, pallid bats are of special concern. *Troy L. Best*

Allen's big-eared bat (*Idionycteris phyllotis*) is one of several species of bats listed as of special concern in the United States.*J. Scott Altenbach*

Status of Endangered Wildlife in Canada has determined that there is insufficient information available to make informed judgments about their conservation status; they are designated "data deficient."

For additional information concerning these species see the appendix.

ENDANGERED SPECIES AND SUBSPECIES

INDIANA BAT (INDIANA MYOTIS), *Myotis sodalis*

The Indiana bat was listed as endangered throughout its range in the United States by the U.S. Fish and Wildlife Service in March 1967 under the Endangered Species Preservation Act of 1966 and is currently listed as endangered under the Endangered Species Act of 1973. A recovery plan for this species was approved (on an interim basis) in June 1976 and a final plan was approved in October 1983. In 1995, the Indiana bat recovery team began revising the plan; a technical draft Indiana bat recovery plan was prepared in October 1996. An agency draft Indiana bat recovery plan was completed in March 1999. As of early 2011 a final draft plan had not been approved.

Hibernating cluster of endangered Indiana bats (*Myotis sodalis*). As many as 5,167 of these bats may occupy a square meter (480 bats per square foot). *Michael J. Harvey*

The range of the Indiana bat is from Oklahoma, Iowa, and Wisconsin eastward to Vermont and southward to northwestern Florida. The total population of this species was estimated to be 387,485 during winter 2009, down from an estimated 883,000 in 1965. From 2001 to 2007, three biennial surveys indicated that the population of Indiana bats had increased by more than 10% during each survey. However, the 2009 survey showed a 17% decline since 2007 (a loss of 80,346 bats).

Numerous caves and mines have been gated to prevent hibernating populations from being disturbed by humans. After several years of increases, the population of Indiana bats (as well as populations of other cave-dwelling species) is again declining, primarily due to mortality from white-nose syndrome.

For additional information about this bat, see the species account.

GRAY BAT (GRAY MYOTIS), *Myotis grisescens*

The gray bat was listed as endangered by the U.S. Fish and Wildlife Service in April 1976. A gray bat recovery plan was prepared by that agency and approved in July 1982. The range of the gray bat is concentrated in the cave regions of Arkansas, Missouri, Kentucky, Tennessee, and Alabama, with a few additional colonies and individuals located in

Unlike most cave-dwelling bats, the endangered gray bat (*Myotis grisescens*) inhabits caves year round. *Roger W. Barbour*

adjacent states. Gates have been placed at openings of numerous caves to protect hibernating, maternity, bachelor, and transient colonies from disturbance by humans. Largely due to this effort, the population of gray bats has more than doubled since 1982 to more than 3.4 million in 2007. However, gray bats infected with white-nose syndrome were discovered in Missouri in 2010. Because of their clustering behavior during hibernation, and the fact that more than 95% of gray bats hibernate in about 15 caves, the disease will likely devastate the population. For additional information about this bat, see the species account.

VIRGINIA BIG-EARED BAT, *Corynorhinus townsendii virginianus*

The Virginia big-eared bat was listed as endangered by the U.S. Fish and Wildlife Service in December 1979. A recovery plan for this

Hibernating cluster of endangered Virginia big-eared bats (*Corynorhinus townsendii virginianus*). *Michael J. Harvey*

Hibernating cluster of endangered Ozark big-eared bats (*Corynorhinus townsendii ingens*). *Michael J. Harvey*

subspecies (and the Ozark big-eared bat) was completed in 1984. At that time, the genus name of this bat was *Plecotus.*

The Virginia big-eared bat is present only in parts of Kentucky, Virginia, West Virginia, and North Carolina. When this subspecies was listed as endangered in 1979, the total population was estimated to be 3,500. This increased to about 10,000 in the 1980s, 15,000 during the 1990s, and more than 18,000 by 2000. The U.S. Fish and Wildlife Service recently completed and approved a Virginia big-eared bat captive propagation plan, the first plan of this type for any species of bat in the United States. A facility has been constructed at the National Zoo and bats have been collected for the project.

For additional information about this bat, see the species account.

OZARK BIG-EARED BAT, *Corynorhinus townsendii ingens*

The Ozark big-eared bat was listed as endangered by the U.S. Fish and Wildlife Service in November 1979. A recovery plan for this subspecies (and the Virginia big-eared bat) was completed in 1984. At that time, the genus name of this bat was *Plecotus.* The recovery plan was subsequently revised and a new plan completed in 1995.

The Ozark big-eared bat occurs only in northwestern and north-central Arkansas and eastern Oklahoma. It is estimated that the total population of this subspecies is about 1,500 individuals.

For additional information about this bat, see the species account.

MEXICAN LONG-NOSED BAT, *Leptonycteris nivalis*

The Mexican long-nosed bat was listed as endangered throughout its range in the United States and Mexico by the U.S. Fish and Wildlife Service in September 1988. The agency completed a recovery plan in May 1994.

In the United States, Mexican long-nosed bats are relatively rare and are known only from southwestern New Mexico and the vicinity of Big Bend National Park in Texas. This species migrates northward from Mexico and is present in the United States only during June, July, and August.

For additional information about this bat, see the species account.

LESSER LONG-NOSED BAT, *Leptonycteris yerbabuenae*

The lesser long-nosed bat was listed as endangered throughout its range in the United States and Mexico by the U.S. Fish and Wildlife Service in September 1988. At that time, it was known as Sanborn's long-nosed bat (*Leptonycteris sanborni*). The U.S. Fish and Wildlife Service completed a recovery plan for this species in May 1994. At that time, this species was considered to be a subspecies of *Leptonycteris curasoae* (*L. c. yerbabuenae,* lesser long-nosed bat). Subsequently, the subspecies was elevated to species status, *Leptonycteris yerbabuenae.*

In the United States, the lesser long-nosed bat is known only from southeastern Arizona and a small area of southwestern New Mexico. This species migrates northward from Mexico and at least 60,000 of these bats are present in the United States from mid-April to mid-October.

For additional information about this bat, see the species account.

HAWAIIAN HOARY BAT, *Lasiurus cinereus semotus*

The Hawaiian hoary bat was listed as endangered by the U.S. Fish and Wildlife Service in October 1970. It occurs only in Hawaii and is the only native terrestrial mammal of Hawaii. The U.S. Fish and Wildlife Service completed a recovery plan for this subspecies in May 1998.

The Hawaiian hoary bat occurs on the islands of Hawaii, Maui, Oahu, Kauai, and Molokai. Size of populations are not known, but these bats are observed regularly only on Hawaii, Kauai, and Maui.

For more information about this bat, see the species account.

The hoary bat (*Lasiurus cinereus*) occurs in southern Canada and every state in the United States except Alaska. The Hawaiian subspecies, the Hawaiian hoary bat (*Lasiurus cinereus semotus*), is listed as endangered. This bat is the only native terrestrial mammal in Hawaii. *Roger W. Barbour*

RESEARCH TECHNIQUES

Before threatened or endangered species and their critical habitats can be protected, studies must be conducted to obtain pertinent data concerning distribution, status, and ecology of these and other species. Studies have been initiated by federal, state, and provincial agencies. Primary objectives are to determine distribution and status of species that are endangered, threatened, or of special concern, to obtain information concerning various aspects of their ecology; and to formulate management recommendations. Gathering data about nonendangered species is a secondary objective.

Research techniques used to inventory species of bats present at a given site have evolved over the years from the use of shotguns, mist nets, and hand collecting (e.g., hibernating bats). For many years, researchers relied on banding techniques to obtain data on various aspects of behavior and ecology. Most banding was done during winter hibernation when bats could be easily captured in caves and mines. More modern techniques include improved mist nets, harp traps, bat detectors, night-vision equipment, chemical lights, data loggers, motion detectors, microchips, acoustic identification (e.g., AnaBat), thermal imaging, and radiotelemetry.

Bat detectors allow ultrasonic calls of bats to be audible to human ears. Much information can be acquired by listening to bats, including where they forage and how many bats are in a habitat. *Troy L. Best*

INVENTORIES

Techniques to inventory bats include searching caves known to have been inhabited by bats and attempting to locate additional caves occupied by bats. Estimates of populations are made by actually counting the number of bats hibernating in caves or mines, or by estimating numbers emerging to forage. For bats that cluster together during hibernation, estimates are made by multiplying the number of bats in a square meter by the area covered by bats. Sometimes, clusters of bats are photographed and then counted later.

Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) exiting a cave in Texas. It is difficult to estimate the number of bats exiting a cave when large populations are involved. *Michael J. Harvey*

For bats inhabiting caves or mines during summer, estimates may be made as the bats emerge. However, these estimates often are inaccurate, especially if large numbers of bats are involved. A relatively new technique, the use of thermal-infrared-imaging cameras, has proven to be superior to estimates made by direct counting. There is increasing evidence that, in the past, estimates made from direct counts of emerging bats greatly overestimated the number of bats exiting roosts in caves or mines.

THERMAL IMAGING

Because bats are endothermic (warm blooded), digital-thermal-imaging techniques can be used to estimate the number of bats emerging from caves. A night-vision camera is used because emergences occur under low-light conditions and illumination in the visible light band may alter the behavior of bats. The technique is based on using a change-detection procedure to detect and track bats flying through the field of view of the camera and evaluating the tracked pattern to count bats exiting and returning to the cave. The procedure can be used on imagery collected with thermal-infrared cameras, which take "heat pictures" without any illumination. This technique has been especially useful in estimating populations of summer colonies of the endangered gray bat, *Myotis grisescens*.

Thermal imaging, involving the use of thermal-infrared cameras, can provide reasonable estimates of the number of bats leaving or entering caves. This information is useful in monitoring the size of populations. *Troy L. Best*

NETS AND TRAPS

Outside caves or mines (or sometimes at openings of caves and mines), sampling for the presence of bats is done by setting up mist nets or by using harp traps at locations where bats would likely fly. Mist nets are large (up to 3 by 18 meters [10 by 60 feet]) and made of very fine thread. They are used to capture flying bats, which become entangled in the nets. Harp traps consist of two large frames, about 10 centimeters (4 inches) apart, over which are strung very thin vertical wires (or monofilament), 2.5 centimeters (1 inch) apart. Bats flying into a harp trap detect and avoid the first set of wires, then hit the second set of wires and gently fall into a collecting bag. Seldom is a bat injured by a mist net or harp trap.

Big brown bat (*Eptesicus fuscus*) caught in a mist net. Bats become entangled in the mist net but are unharmed by this capturing technique. *J. Scott Altenbach*

Biologists preparing mist nets to capture bats over an isolated pond in the Chihuahuan Desert of southwestern New Mexico. These watering sites often attract large numbers of bats in desert habitats. *Troy L. Best*

Mist nets, used to capture bats, can be "stacked" to cover larger areas. Here researchers have stacked four 18.3- by 2.1-meter (60- by 7-foot) mist nets and use a flagpole-like system to raise and lower the nets. A single shorter net also has been erected over this stream in Kentucky. *Michael J. Harvey*

Harp traps are especially effective in capturing bats that can be funneled into constricted spaces, such as openings of caves. This trap consists of two 1.27- by 1.52-meter (5- by 6-foot) frames, spaced 10 centimeters (4 inches) apart; each is strung with vertical monofilament line 2.54 centimeters (1 inch) apart. Beneath the frame is a canvas collecting bag. *Michael J. Harvey*

BAT BANDING

Use of bands to mark bats for later identification has provided researchers with a wealth of information concerning migration, movements, homing ability, longevity, size of populations, survival, sex ratios, age of individuals, rates of growth, and so on. From 1932 to 1972, a bat-banding program was administrated, coordinated, and maintained by the U.S. Bureau of Biological Survey in the Department of Agriculture, and its successor, the U.S. Fish and Wildlife Service in the Department of the Interior. Bands were issued and copies of permanent records were maintained by the Bird and Mammal Laboratories at the National Museum of Natural History. Files for this program are in the same location but are now under the auspices of the Department of the Interior, U.S. Geological Survey, Patuxent Wildlife Research Center, Biological Survey Unit at the Smithsonian Institution National Museum of Natural History.

From 1932 to 1972, nearly 1.5 million bands were placed on 36 species of bats by researchers in the United States, Canada, Mexico, and Central America. However, because injury to the delicate wings of bats apparently caused by the bands, as well as the disturbance to hibernating and summer colonies, a moratorium on banding was placed into effect in 1973. Since that time, the use of standard forearm bands has been discouraged, unless the information gained from the banding projects was likely to outweigh the potential negative effects on the bats.

The original aluminum bands, designed to be used on the legs of birds, were larger and heavier than those now in use on bats. Information on bands was as follows:

WRITE F.&W. SERV.
876-54321
WASH. D.C. USA

Later, a "lipped" band (designed to avoid injury to the delicate wings of bats) was used, with the following information:

NOTIFY NAT. MUS. FWS.
BAT-6-54321
WASH. D.C. 20560

Bands currently in use are much smaller and lighter. However, much less information can be placed on a band:

TN TECH U
4321

These newer lipped bands are usually made of metal or plastic and can be obtained in a variety of colors. The U.S. Fish and Wildlife Service no longer provides bands nor does it serve as a clearinghouse for recovery of bands. Researchers must depend on one another or the public for information about recoveries.

Bats are banded on the forearm to determine movement and migration patterns, as well as longevity and other aspects of their biology. This Brazilian free-tailed bat (*Tadarida brasiliensis*) was banded with a U.S. Fish and Wildlife Service band. Currently, smaller bands are used. *J. Scott Altenbach*

RADIOTELEMETRY

Some bats are fitted with tiny radiotransmitters and their movements are tracked with directional antennae and radio receivers. These transmitters should weigh no more than 5%–10% of the weight of the bat. Unfortunately, because of their small size and short battery life, transmitters only have a range of a few kilometers, depending on environmental conditions, and transmit for only a few weeks. This technique has been especially helpful in studying nightly activity and in locating summer roost sites of several species that roost under loose bark of dead trees or in other cryptic locations.

Radiotransmitter attached to an endangered gray bat (*Myotis grisescens*). Bats equipped with radiotransmitters can be located using a radio receiver and antenna. This method is useful for finding maternity colonies in trees, locating hibernation sites, determining foraging areas, and mapping movement patterns among roosting sites. *Troy L. Best*

Antenna used with a radio receiver to monitor signals from bats carrying radiotransmitters. *Troy L. Best*

Radio receiver used to monitor signals from bats carrying a radiotransmitter. *Troy L. Best*

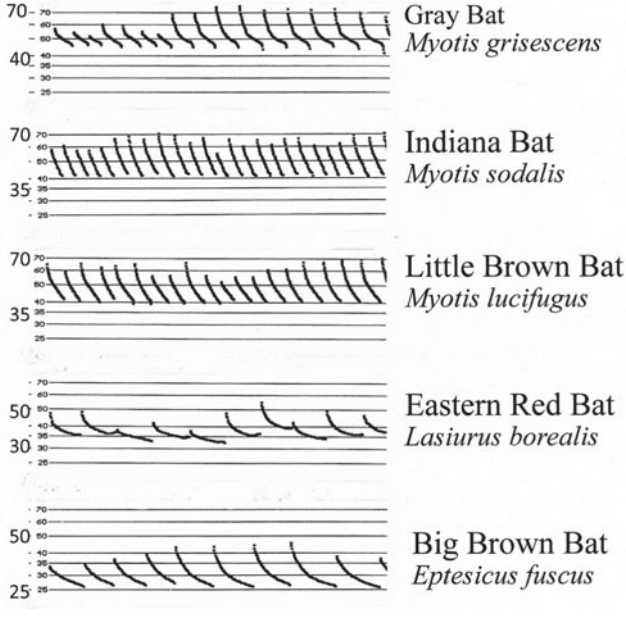
ACOUSTIC IDENTIFICATION

Acoustic identification equipment, such as the AnaBat Bat Detector, can be used to identify bats to species. This bat-detector system renders ultrasonic calls made by bats audible to humans. Recordings of the search-phase calls of free-flying bats produce sonograms, which vary among species. The AnaBat system can be used to

1. locate sites with high activity for subsequent mist netting;
2. examine use of habitats;
3. identify species of bats once a library of known calls has been recorded; and
4. compare capturing techniques with acoustical methods.

This technique is extremely useful in identifying species of bats at a particular site. However, numbers of each species detected may be misleading, because one bat may be recorded multiple times. Mist-netting, which requires checking the net about every 20 minutes, may result in the capture of few bats (perhaps 20 in a typical 5-hour period), whereas the AnaBat system can record more than 1,000 files in a similar time period. And, more important to researchers, the AnaBat system can be left unattended. Use of the AnaBat system usually results in identification of more species of bats at a site than the standard mist-netting technique.

The AnaBat monitoring system is an effective means of identifying species of bats and assessing biodiversity. Here the system is being used to determine species of bats foraging over a small lake in the Ozark National Forest of Arkansas. *Michael J. Harvey*



AnaBat sonograms of five common species of bats. Each sonogram illustrates shape and frequency of echolocation calls. *Michael J. Harvey*

ADDITIONAL TECHNIQUES

Night-vision (or starlight) scopes and ultrasonic detectors are used to observe bats at night. Bats may also be fitted with small vials containing a chemical light substance (Cyalume) so researchers can observe their flight behavior, determine foraging habitat, and track movements. Environmental conditions in roost sites are monitored with electronic data loggers to determine microclimate factors such as temperature and humidity. These tiny data loggers can even be attached directly to bats. Activity by humans in ungated caves and mines can be monitored with light-sensitive or motion-sensitive devices that record date and time of a disturbance.

Some bats have been tagged with microchips for later identification. Data on temperature and humidity at roost sites can be obtained, as well as information on sex ratios, reproduction, swarming, longevity, diet, mortality, effects of cave gates and fences, and various other behavioral and ecological data. Long-term monitoring programs have been initiated to determine population trends over time and ascertain the effectiveness of management measures already initiated.

Some tools used by researchers to study bats: radiotransmitter and battery, vial that can hold chemical light (Cyalume) used to observe flight of bats at night, and several types of bands for wings (the small colored bands are used by most researchers). *Michael J. Harvey*

MEXICAN LONG-TONGUED BAT

Choeronycteris mexicana
Special Concern–United States

Weight is 10–25 grams (0.4–0.9 ounce); wingspan is 33–36 centimeters (13–14 inches); distribution includes the southwestern United States, most of Mexico, and Central America. It is a rather large bat with a long, slender nose. This species occupies a variety of vegetative habitats ranging from arid thorn shrub to tropical deciduous forest and mixed oak-conifer forest. It is believed to migrate seasonally to take advantage of suitable sources of food. Buildings and culverts occasionally are occupied, but caves and abandoned mines seem to be favored as daytime roosts; these bats hang in dimly lit areas near the entrances, so even small caves are occupied. In roosts, they do not cluster, but hang about 2–5 centimeters (1–2 inches) apart, usually by only one foot, so that they can rotate 360° to detect predators. Mexican long-tongued bats are extremely wary, thus easily disturbed, and they readily leave the roost, preferring to fly out into open daylight rather than to retreat deeper into large shelters. In flight, the wings make a swishing sound similar to that produced by long-nosed bats. Foods include fruits, pollen, nectar, and insects. One baby is born in June or July, but parturition may be as late as September in Mexico. As with many other bats, the fetus is about 30% of the weight of the mother. Parturition takes about 15 minutes. Babies are born in a remarkably advanced state of development and are well furred. A mother may carry her rather large baby while she is foraging. The Mexican long-tongued bat is rare in the United States and has been proposed for listing as threatened or endangered.

MEXICAN LONG-NOSED BAT

Leptonycteris nivalis
Endangered–United States

Weight is 23–25 grams (0.8–0.9 ounce); wingspan is 40–42 centimeters (16–17 inches); distribution extends from the Big Bend region of Texas, southward across most of Mexico to central Guatemala. It is a colonial cave dweller that usually inhabits its deep caverns but also occurs in mines, culverts, hollow trees, and unoccupied buildings. This bat occupies a variety of habitats from high-elevation, pine-oak woodlands to sparsely vegetated deserts. The muzzle is greatly lengthened and this bat has a long protrusive tongue, which is attached to the posterior sternum. Rows of hairlike projections that cover the area near the tip of the tongue aid in acquiring nectar. This bat emerges relatively late in the evening to feed. The Mexican long-nosed bat is an agile flyer, capable of quick maneuvering and relatively high-speed flight. It makes swooshing sounds as it flies and can fly straight up while maintaining a horizontal body position. It feeds primarily on nectar, pollen, insects, and soft, succulent fruits of cactus during the nonflowering season. When foraging at agaves, it crawls down the stalk, thrusts its snout into the flowers, and licks nectar from them with its long tongue. The tongue, which can be extended up to 7.5 centimeters (3 inches), can reach nectar at the base of the corolla of the flowers. The bat emerges from the flowers covered with pollen and is an effective pollinator of many cacti, agaves, and other plants. One baby is born in April, May, or June. The Mexican long-nosed bat is rare in the United States and is considered endangered.

LESSER LONG-NOSED BAT

Leptonycteris yerbabuenae
Endangered–United States

Weight is 15–25 grams (0.5–0.9 ounce); wingspan is 37–38 centimeters (15 inches); distribution is from the southwestern United States to Honduras. A resident of desert-scrub country, it is colonial, occupying mines and caves at the base of mountains where the alluvial fan supports agaves, yuccas, saguaros, and organ pipe cacti. It hangs with its feet so close together that it can turn nearly 360° to watch for predators. Like other leaf-nosed bats, it will take flight when disturbed. When launching, it gives several strong wing beats, bringing the body into a horizontal position before releasing its grip. The lesser long-nosed bat is an agile flier and can fly nearly straight up while maintaining a horizontal body position. Flight is rapid and direct, showing none of the fluttering movements characteristic of most insectivorous bats. It emerges late in the evening, about 1 hour after sundown. The long tongue, covered with hairlike papillae toward the tip, is well adapted for feeding at flowers. These bats may land on the flowering stalk of agaves and insert their long snouts into each blossom. After feeding, the stomach is so distended that the bat appears to be in late pregnancy. When the stomach is filled, bats retire to a night roost where they hang up and rest. Nectar, pollen, and insects are consumed, but fruits are eaten after the flowering season is past. One baby is born in late May or June. Maternity colonies may number into the thousands. The lesser long-nosed bat is considered endangered throughout its range in the United States and Mexico.

CALIFORNIA LEAF-NOSED BAT

Macrotus californicus

Special Concern–United States

Weight is 8–17 grams (0.3–0.6 ounce); wingspan is 33–35 centimeters (13–14 inches); distribution is the southwestern United States, western and southern Mexico, and northern Central America. This rather large bat is a resident of lowland desert habitat. Its favored daytime retreat is abandoned mine tunnels, which provide protection from the heat and the drying effects of the desert climate. When at rest, the bat hangs pendant by gripping the ceiling of its roost with one or both feet. Much of the time at rest is spent hanging from a single foot with the other leg relaxed and dangling to the side. The free foot is used for scratching and grooming as the bat swings gently, like a pendulum. This species, like most other bats, uses resting places during its nocturnal forays. These night roosts include open buildings, cellars, porches, bridges, rock shelters, and mines. Emergence from the day roost begins about an hour after sunset, considerably later than for most other species of bats, and is spread over about 3 hours, with small groups of bats often leaving together. Grasshoppers, cicadas, moths, caterpillars, and beetles are consumed. Remains of sphinx moths, butterflies, and dragonflies have been found beneath night roosts. Although twins are known, usually one baby is born sometime between mid-May and mid-July. The California leaf-nosed bat has been proposed for listing as threatened or endangered.

JAMAICAN FRUIT-EATING BAT

Artibeus jamaicensis

Weight is 42–44 grams (1.5 ounces); wingspan is 44–46 centimeters (17–18 inches). This fruit-eating bat is widely distributed from northern Sinaloa, Mexico, and from the Florida Keys southward through the Caribbean and northern South America. The Jamaican fruit-eating bat forages in small groups. Captured individuals may produce distress calls, which induce mobbing behavior by other members of the group. These bats are less active on bright moonlit nights than on dark nights. Roosts may be in buildings, caves, or hollow trees; sometimes they build tents by biting the midribs causing folding of large leaves. Possible predators include owls and falcons. The species eats mostly fruits of fig trees, but also mangos, avocados, and bananas. It also feeds on pollen, nectar, flower parts, and sometimes insects. Food passes through the digestive tract in 15–20 minutes. The reproductive period of the Jamaican fruit-eating bat is closely tied to the maximum abundance of figs. The species is polygynous; males may accumulate harems of up to 25 females. Besides harems, Jamaican fruit-eating bats also form groups of bachelor males and groups of nonreproductive females. Usually, one baby is born to each female in March or April, but twins also may be born. Lifespan is 7–10 years. Rare in the United States, this species is known only from the Florida Keys. Elsewhere in its range, the Jamaican fruit-eating bat is one of the most common bats.

PETER'S GHOST-FACED BAT

Mormoops megalophylla

Weight is 13–19 grams (0.5–0.6 ounce); wingspan is 36–38 centimeters (14–15 inches). Distribution is southeastern Arizona and across southern Texas, throughout most of Mexico (except northwestern region), then southward into Central America. Peter's ghost-faced bats usually occur in lowland areas, especially desert scrub and riverine habitats, where they often roost in caves, tunnels, and mine shafts. They may also inhabit old buildings. Although they may congregate in large numbers at a roosting site, this species tends not to form compact clusters. Instead, members of the colony roost singly, spread about 15 centimeters (6 inches) apart over the ceiling of a cave. When asleep, individuals rest with the back arched and the head tucked almost to the chest. Peter's ghost-faced bat emerges late in the evening and its flight is strong and swift. In Mexico, this species may be so abundant that it produces large deposits of guano (feces). This material, rich in nitrogen from the exoskeletons of the insects upon which the bats feed, is used by the local people as fertilizer. Foods include large moths and other insects. One baby is born in late May or early June. It is a common winter resident in caves along the southern edge of the Edwards Plateau, Texas, but its occurrence at specific localities is highly variable and unpredictable.

FLORIDA BONNETED BAT

Eumops floridanus

Special Concern–United States

Weight is 30–55 grams (1.1–1.9 ounces) in pregnant females; wingspan is 49–51 centimeters (20 inches). The Florida bonneted bat occurs only in southern Florida. Although these bats occur in cities as well as in forested areas, precise foraging and roosting habits and long-term requirements are unknown. In Florida, favorite daytime roosts are under the shingles of Spanish-tile roofs, but some have been found in shafts of leaves of royal palms, in low shrubbery, in places where there are lush growths of tropical flowers and shrubs, in limestone cliffs, and in bat houses. One colony was in a cavity in a longleaf pine. At any time during the year, juveniles, adult males, and adult females may occur in the same roost. Unlike most other free-tailed bats, which need to drop 8–10 meters (about 25–35 feet) from a roost before they can fly, the Florida bonneted bat can take flight from horizontal surfaces. These bats leave their roost after dark and seldom fly below 10 meters (30 feet). Their loud, piercing calls can be heard for some distance, and once a person recognizes this call, it can easily be differentiated from other nighttime sounds. They do not migrate. The diet includes beetles, flies, mosquitoes, true bugs, moths, and other insects. One baby is born in June, July, August, or September. Florida bonneted bats are rare and the species has been proposed for listing as threatened or endangered.

GREATER BONNETED BAT

Eumops perotis

E.p. californicus, Special Concern–United States

Weight is 60–70 grams (2.1–2.5 ounces); wingspan is 53–57 centimeters (21–22 inches); distribution is central California to central Mexico and northern South America to northern Argentina. It is capable of fast and prolonged flight; the wings are long and slender and the flight membranes are tough and leathery. These bats live in high, dry places. They usually cannot get airborne from the ground and will scramble to a post or a tree to gain height for launching. In the southwestern United States, the greater bonneted bat is most common in rugged rocky canyons and cliffs, where crevices provide favored daytime retreats. Colonies are small, usually fewer than 100, and adult males sometimes are present in maternity colonies. Some roosting sites are occupied throughout the year, but the four seasons usually are spent in different roosts. This species produces a high-pitched call that can be heard when they are flying up to 300 meters (about 1,000 feet) above the ground. Males have a dermal gland that becomes enlarged during the mating season. When enlarged, this gland produces a thick, oily secretion with a strong odor that may serve to attract females. Greater bonneted bats feed on insects, including dragonflies, grasshoppers, beetles, true bugs, moths, wasps, and ants. Mating occurs in early spring when the dermal gland of the male is most functional. Dates of parturition usually vary more in this species than in any other bat in the United States; May, June, July, August, or September. One baby ordinarily is born; twins are rare. The subspecies that occurs in the United States, *E. p. californicus* (western bonneted bat), has been proposed for listing as threatened or endangered.

UNDERWOOD'S BONNETED BAT

Eumops underwoodi

Special Concern–United States

Weight is 50–60 grams (1.8–2.1 ounces); wingspan is 50–54 centimeters (20–21 inches); distribution is in south-central Arizona, then along the western coast of Mexico into Central America. Among bats of the United States, this species is second in size only to the greater bonneted bat. Its long, narrow wings are adapted for rapid, long-distance flight in open habitats. The flight speed is at least 43 kilometers per hour (26 miles per hour). As in other free-tailed bats, the distal part of the tail is not attached to the interfemoral membrane. It is known in the United States only in the vicinity of the Baboquivari Mountains, Arizona. Information on habitat of this species in the United States is scarce (we only know that it may fly over livestock watering tanks in the mesquite desert of southern Arizona), and its distribution in winter is unknown. It occurs in a variety of habitats in Mexico and Central America, including arid lowlands, grasslands, and pine-oak and deciduous forests; one was present during the day beneath the leaf of a royal palm. Roosts are in high, dry places; one roost was in a large, hollow tree. Its presence can be detected by listening for the high-pitched "peeps" emitted several times a minute in flight. The calls may be intense enough to hurt the ears of anyone standing close by when these bats are flying. This insectivorous bat consumes grasshoppers, leafhoppers, moths, and a variety of beetles. One baby is born in late June or in July. Underwood's bonneted bat is rare in the United States and has been proposed for listing as threatened or endangered.

PALLAS' MASTIFF BAT

Molossus molossus

Weight is 13–15 grams (0.5 ounce); wingspan is 29–31 centimeters (11–12 inches). This species is widely distributed from northern Mexico and from the Florida Keys southward through the Caribbean and northern South America to northern Argentina. Throughout its broad range, this species commonly is associated with human dwellings; it also roosts in hollow trees, crevices in rocks, caves, tunnels, culverts, and bridges. Females form nursery colonies at the beginning of the rainy season in buildings, hollow trees, or caves. Individuals also have been known to roost in palm fronds. The three known colonies in the Florida Keys are all in the roof spaces of flat-roofed buildings. Temperatures in roosts of this species may reach 55°C (131°F). These bats fly rapidly, in the manner of swifts. Pallas' mastiff bats forage near streams in dry deciduous forest and moist-tropical evergreen forest. In drier areas, they often forage near man-made ponds. This mastiff bat eats insects including moths, beetles, and flying ants. One baby is born in June–September. Mothers leave their baby in clusters of other babies when they go to forage. Upon returning, mothers identify their baby by its calls. Weaning occurs when babies are about 65 days old. Rare in the United States, this species is known only from the Florida Keys, but throughout most of its range, Pallas' mastiff bat is common.

POCKETED FREE-TAILED BAT

Nyctinomops femorosaccus

Weight is 10–14 grams (0.4–0.5 ounce); wingspan is 34–35 centimeters (13–14 inches); distribution is from the southwestern United States to south-central Mexico. The common and scientific names refer to a shallow fold of skin that forms a pocketlike structure on the underside of the interfemoral membrane near the knee. The pocketed free-tailed bat occurs in arid lowlands of the desert Southwest, and primarily roosts in crevices in rugged cliffs, slopes, and tall rocky outcrops. Colonies are small, usually fewer than 100 individuals. In day roosts, these bats squeak or chatter much of the time. They generally leave the roost well after dark. When first taking flight, pocketed free-tailed bats produce shrill, sharp, high-pitched chattering calls that may continue while the bats are in flight. As with other free-tailed bats, flight is swift and lacks the fluttering characteristic of many other bats. At stock ponds and other water sources, they fly swiftly about the pool, making distinctly audible whistling and fluttering sounds with their wings. To drink, these bats will hit the water hard while in flight and scoop up a mouthful of water. Moths are common prey; other foods include beetles, flying ants, flies, leafhoppers, crickets, stinkbugs, lacewings, and grasshoppers. One baby is born in late June or July. The pocketed free-tailed bat is uncommon in the United States.

BIG FREE-TAILED BAT

Nyctinomops macrotis

Special Concern–United States

Weight is 25–30 grams (0.9–1.1 ounces); wingspan is 42–44 centimeters (17 inches); distribution is in the southwestern United States, Caribbean, and Central America through northern South America. The big free-tailed bat inhabits rocky country, where it roosts in crevices high up on cliff faces. It has been known to roost in buildings. This bat leaves its roost late, when it is quite dark. As the species is incapable of hibernation, the northern populations are believed to be migratory. In Utah, the northern part of the distributional range of the species, individuals are present from the latter half of May to mid-September, but none are present in winter. This bat is a fast and powerful flier, and after the young are weaned, individuals may appear hundreds of kilometers beyond what seems to be the usual range. Records of accidental occurrence are widespread in North America. There are autumn records from Iowa and British Columbia. When foraging, the big free-tailed bat usually emits a loud piercing chatter. Parasites include bat bugs and fleas. Diet consists primarily of large moths but may include crickets, flying ants, stinkbugs, and leafhoppers. Maternity colonies are formed by females, who give birth to one baby in June or July. The big free-tailed bat is uncommon throughout most of its range and has been proposed for listing as threatened or endangered.

BRAZILIAN FREE-TAILED BAT

Tadarida brasiliensis

Weight is 11–15 grams (0.4–0.5 ounce); wingspan is 29–35 centimeters (11–14 inches); distribution is in the southern United States and southward through Mexico and Central America into northern South America. It also occurs on islands of the Caribbean. Habitat of Brazilian free-tailed bats differs in various parts of the United States. In the Southwest, they are primarily cave bats that migrate long distances into Mexico or beyond to overwinter. During summer, about 20 million bats of this species occupy Bracken Cave near San Antonio, Texas; this is the largest concentration of mammals in the world. In the Southeast, this species does not occur in caves; it is present only in man-made structures. In addition, populations in the southeastern United States do not migrate great distances (if at all), and few colonies larger than several hundred individuals are known. Brazilian free-tailed bats often select hot attics and caves as roosts; the babies seem to be able to tolerate higher temperatures than adults. High temperatures in roosts are essential for rapid growth of young bats; apparently, the larger the colony, the less expenditure of energy per bat to maintain a given temperature. This species usually feeds on small moths and beetles. One baby is born in late spring or early summer. Birth occurs with the mother hanging head downward. Passage of the baby through the birth canal requires about 90 seconds. Newborn are hairless but have all their milk teeth. A mother can locate her own baby among the thousands of babies in a colony. The subspecies inhabiting the southwestern United States in summer, the Mexican free-tailed bat (*T. b. mexicana*), is present in very large numbers. It has been estimated that more than 100 million are present in Texas alone during summer. The subspecies that occurs in the southeastern United States, LeConte's free-tailed bat (*T. b. cynocephala*), is only locally common.

BIG BROWN BAT

Eptesicus fuscus

Weight is 14–21 grams (0.5–0.7 ounce); wingspan is 32–39 centimeters (13–15 inches). Distribution is from southern Canada through southern North America into South America, including many islands in the Caribbean. These bats are closely associated with humans and more people in the United States are familiar with this bat than with any other species of bat. Most summer roosts are located in attics, barns, bridges, or other man-made structures, where colonies of a few to several hundred individuals gather to form maternity colonies. They move into caves, mines, and other underground structures to hibernate only during the coldest weather. Where most of these bats spend the winter remains unknown. The big brown bat emerges at dusk and flies a steady, nearly straight course at a height of about 6–10 meters (20–35 feet) to foraging areas. Its large size and steady flight make it readily recognizable. Apparently, some individuals use the same feeding ground each night, for a bat can sometimes be seen following an identical feeding pattern on different nights. After feeding, the bat flies to a night roost to rest; favored night roosts include garages, breezeways, and porches of houses. These bats consume beetles, ants, flies, mosquitoes, mayflies, stoneflies, and other insects. Mating occurs in autumn and winter. Females store sperm and fertilization takes place in spring. In the eastern United States, big brown bats usually bear twins in early June. In the western United States, usually only one baby is born each year. The big brown bat is common throughout most of its range.

WESTERN RED BAT

Lasiurus blossevillii

Weight is 10–15 grams (0.4–0.5 ounce); wingspan is 29–30 centimeters (11–12 inches); distribution is western Canada, western United States, western Mexico, and Central America. This solitary species roosts in the foliage of large shrubs and trees in habitats bordering forests, rivers, cultivated fields, and urban areas. In the southwestern United States, the western red bat occurs in streamside habitats dominated by cottonwoods, oaks, sycamores, and walnuts; it is rarely encountered in desert habitats. In Mexico, it occurs near streams, in arid thorn scrublands, and in pine-oak forests. This species is believed to be migratory in much of the Southwest and has been reported there only during summer. There are various accounts of its presence during winter and summer in California. For example, the western red bat is resident through winter (September–May) in the vicinity of San Francisco but absent in summer. About 100 kilometers (60 miles) to the northeast it is absent in winter but appears in February or March. The western red bat consumes a variety of moths and other insects. Few data on reproductive biology are available. In mid-May to late June, up to three babies may be born. It is common throughout its range.

EASTERN RED BAT

Lasiurus borealis

Weight is 9–15 grams (0.3–0.5 ounce); wingspan is 28–33 centimeters (11–13 inches). Distribution includes southern Canada, the eastern United States (except the Florida peninsula), and northeastern Mexico. Eastern red bats spend daylight hours hanging in foliage of trees. They usually hang by one foot, giving them the appearance of dead leaves. Although these bats seldom venture any distance into caves, they often swarm about cave openings in autumn. In colder parts of their range, they may migrate south in winter or hibernate in hollow trees or leaf litter. These bats are almost completely furred, except for the ears and parts of the wings, and they can respond to subfreezing temperatures by increasing their metabolism. Predators include several kinds of birds, especially blue jays. Eastern red bats emerge early in the evening and often fly on warm winter afternoons. They forage regularly over the same territory on successive nights. They commonly feed beneath street lights. Eastern red bats consume moths, crickets, flies, mosquitoes, true bugs, beetles, cicadas, and other insects. They mate in flight during August and September; sperm are stored over winter; and females give birth to one to four babies (average is three) during late spring or early summer. Babies are born hairless, with the eyes closed. They cling to the fur of the mother with their teeth, thumbs, and feet. The eastern red bat is common throughout most of its range.

HOARY BAT

Lasiurus cinereus

L. c. semotus, Endangered–United States

Weight is 25–30 grams (0.9–1.1 ounces); wingspan is 34–41 centimeters (13–16 inches). This is the most widespread bat in the Americas, occurring in most of southern Canada and southward through most of South America. It also occurs in Hawaii (where it is the only native terrestrial mammal), Iceland, Bermuda, and the Dominican Republic. Large, heavily furred bats, they spend summer days concealed in the foliage of trees. They choose a leafy site that is well covered above but open from beneath, generally 3–5 meters (10–15 feet) above the ground, and usually at the edge of a clearing. In late summer, they may wander into caves; many of these bats never find their way out. Because hoary bats rarely enter houses and usually spend the daylight hours well concealed, humans seldom encounter them. Northern populations make long seasonal migrations to and from warmer winter habitats. The sexes apparently are segregated throughout most of the summer range; males are uncommon in the eastern United States at that time. Hoary bats may fly during late afternoon on warm days in winter. Their swift and direct flight pattern and large size make them readily identifiable on the wing in most parts of the range. Moths, true bugs, mosquitoes, other insects, and occasionally other bats may be captured as food. This species has been reported to fly as high as 2,440 meters (8,000 feet). Hoary bats bear two babies in mid-May, June, or early July. The young cling to the mother through the day, but are left hanging on a twig or leaf while she forages at night. Although relatively common throughout most of North America, the Hawaiian subspecies, *L. c. semotus* (Hawaiian hoary bat), is considered endangered.

SOUTHERN YELLOW BAT

Lasiurus ega

Weight is 10–15 grams (0.4–0.5 ounce); wingspan is 34–36 centimeters (13–14 inches); distribution is from southern Texas through eastern Mexico and Central America into southern South America. Like other members of the genus *Lasiurus,* the southern yellow bat is a tree-roosting species; it often roosts individually on the bark of trees. Palm trees are a common roosting site; most records in the United States are along the Rio Grande near Brownsville, Texas, where it inhabits a natural grove of palm trees. It may be migratory in parts of its range, but it seems to be a year-round resident of the Brownsville area, where it is known to occur in six different months, including December. It does not hibernate, but it does undergo daily torpor. In Venezuela, it usually occurs at elevations below 500 meters (about 1,600 feet), and is strongly associated with moist habitats and multistratal tropical evergreen forest. Small to medium-size night-flying insects are the main food items. Pregnant individuals have been recorded in April and June. One litter of two to four babies (average is three) is born in late April, May, June, or July. Young are capable of breeding in their first year. The southern yellow bat is rare in the United States but is common in the southern extreme of its range in Paraguay, Uruguay, and Argentina.

NORTHERN YELLOW BAT

Lasiurus intermedius

Weight is 14–31 grams (0.5–1.1 ounces); wingspan is 35–39 centimeters (14–15 inches). Distribution includes the coastal regions of the southeastern United States, eastern Texas, Cuba, and southward into Central America. These bats typically inhabit wooded areas in the vicinity of permanent water. In the southeastern United States, the distribution of northern yellow bats nearly coincides with that of Spanish moss, where they often roost and bear their young. A single oak tree draped with Spanish moss may harbor several of these bats. In some parts of Florida, it is the most abundant bat. Northern yellow bats are somewhat colonial, especially females during the nursing season. As with most other bats, the mother hardly ever carries her young while foraging, but mothers carry their young when they are flushed from their day roosts. In June–August, the young have begun to fly, and they form evening feeding aggregations with adult females. Males rarely are in these aggregations; they are believed to be solitary and scattered at this time of year. Northern yellow bats usually forage 5–7 meters (about 15–25 feet) above the ground over open areas with few shrubs and only scattered clumps of trees, or along the edge of forests. Grassy areas, such as airports, open pastures, golf courses, and edges of lakes, are favored. True bugs, flies, mosquitoes, beetles, and other insects are important components of the diet. Mating occurs in autumn and winter. Two to four babies are born in May or June. Newborn weigh about 3 grams (0.1 ounce). The northern yellow bat is relatively common throughout most of its range.

SEMINOLE BAT

Lasiurus seminolus

Weight is 9–14 grams (0.3–0.5 ounce); wingspan is 29–31 centimeters (11–12 inches). Distribution is the southeastern United States; extralimital records include New York, Pennsylvania, southern Texas, Bermuda, and Veracruz, Mexico. The distribution of Seminole bats nearly coincides with that of the Spanish moss where they often roost, but they also are known to roost beneath loose bark, in clumps of foliage, and in caves. These bats often select roost sites in moss hanging on the southwestern side of trees. The height of clumps of Spanish moss occupied by Seminole bats is variable, but the moss is high enough in the tree for the bat to drop into the unobstructed space beneath when initiating flight. These are the most common bats seen flying in the evening throughout much of the southeastern United States. They fly during all seasons, even on warm evenings in midwinter. This species emerges early in the evening from daytime roosts and usually feeds at treetop level. The flight is direct and usually rather swift. Seminole bats consume true bugs, flies, mosquitoes, beetles, crickets, and other insects, which usually are captured around and in the tree canopy. One to four babies are born during late spring or early summer. Like several other species, Seminole bats apparently wander extensively after the young are weaned, as indicated by late summer occurrence outside the breeding range. The Seminole bat is common throughout most of its range.

WESTERN YELLOW BAT

Lasiurus xanthinus

Weight is 10–15 grams (0.4–0.5 ounce); wingspan is 33–36 centimeters (13–14 inches). Distribution is from the southwestern United States across the Mexican Plateau to southern Mexico. Little is known regarding its habitat, but like other lasiurine bats, it roosts in leafy vegetation. Ecologically, western yellow bats seem to be associated with the dry thorny vegetation of the Mexican plateau; coastal western Mexico, including parts of Baja California; and the deserts of the southwestern United States. In New Mexico, it is known to roost in hackberry and sycamore trees. In Arizona, some western yellow bats apparently hibernate among the dead fronds of palm trees, as several were found in these trees in Tucson during January and February. This bat may be extending its range in the United States as evidenced by its appearance at several sites in Arizona in recent years. Studies have shown this species is genetically different from the southern yellow bat (*Lasiurus ega*). It consumes small to medium-size night-flying insects. Usually, two babies are born in June, but the presence of up to four embryos suggests that size of litter may vary from two to four. The western yellow bat is common in south-central Arizona, but uncommon elsewhere in its range in the United States.

EVENING BAT

Nycticeius humeralis

Weight is 7–14 grams (0.2–0.5 ounce); wingspan is 26–28 centimeters (10–11 inches); distribution is most of the eastern United States and northeastern Mexico. This species usually inhabits tree cavities or buildings in summer. In the Southeast, it may share roosts with the Brazilian free-tailed bat. It almost never enters caves, although it sometimes joins the bats swarming about certain cave openings in late summer. Maternity colonies in buildings sometimes contain hundreds of individuals. Smaller colonies may occur behind loose bark of dead pines and in hollow cypress trees. Winter habitat is almost completely unknown, but evening bats accumulate large reserves of fat in autumn, sufficient for either hibernation or a long migration. This species emerges early and flies a slow and steady course. Heavy rain and cold temperatures retard activity, and females nursing young return to the roost periodically to care for their offspring. The evening bat consumes a variety of small insects. Babies are born in nursery roosts sometime between mid-May and mid-June. The usual litter size is two. As with most other species of bats, birth is by breech presentation (i.e., the tail-end exits the birth canal first). After the babies are born, they grasp a nipple within 5–8 minutes. Newborns are pink, except for slightly darker feet, membranes, ears, and lips; their skin is so transparent that the viscera can be seen. Lifespan is greater than 5 years. Although less common through most of its range, it is one of the most common bats throughout the southern coastal states.

CANYON BAT (formerly Western Pipistrelle)

Parastrellus hesperus

Weight is 3–6 grams (0.1–0.2 ounce); wingspan is 19–22 centimeters (7–9 inches); distribution is from southern Washington to southern Mexico. The genus of this bat recently was changed from *Pipistrellus* to *Parastrellus*. There is no bat in the genus *Pipistrellus* in the United States or Canada (there were 2), but there are 29 species of *Pipistrellus* elsewhere in the world. This species is now called the canyon bat. However, researchers will likely continue to refer to them as "pips." The canyon bat is one of the smallest bats in the United States. Primarily a desert species, it inhabits a variety of habitats from rocky canyons, cliffs, and outcroppings to creosote bush flats. Day roosts usually are in rock crevices, but may be beneath rocks, in burrows, in mines, or in buildings. It tends to roost singly or in small groups; a maternity colony of 12 individuals is the largest known group of this species. In winter, the canyon bat has been found hibernating in mines, caves, and rock crevices. Among the most diurnal of bats, it often begins foraging flights before sunset and may remain active well after dawn. Except for lactating females, which may be active throughout the night, these bats usually cease early evening activity within 1–2 hours after sunset. The flight is fluttery and among the slowest and weakest of all our bats. A slight breeze can bring these bats to a standstill, and a stronger wind may cause them to seek shelter. This bat forages on swarming insects about 2–25 meters (5–80 feet) aboveground and consumes about 20% of its body weight per feeding. Prey items include caddisflies, stoneflies, moths, small beetles, leaf and stilt bugs, leafhoppers, flies, mosquitoes, ants, and wasps. Twins are born in June or July, after a gestation of about 40 days. Newborn bats weigh less than 1 gram (0.03 ounce), but they grow quickly. Juveniles begin to fly at about 1 month of age. The canyon bat is relatively common throughout most of its range.

TRI-COLORED BAT (formerly Eastern Pipistrelle)

Perimyotis subflavus

Weight is 6–8 grams (0.2–0.3 ounce); wingspan is 21–26 centimeters (8–10 inches). Distribution includes eastern Canada, most of the eastern United States, and southward through eastern Mexico to Central America. The genus of this species recently was changed from *Pipistrellus* to *Perimyotis.* There is no bat in the genus *Pipistrellus* in the United States or Canada (there were 2), although there are 29 species of *Pipistrellus* in other parts of the world. Because of this taxonomic reorganization, it has been suggested that the common name be changed to "tri-colored bat." However, most researchers will likely continue to refer to them as "pips." Caves, mines, and rock crevices are used as hibernation sites in winter, and occasionally as night roosts in summer. These bats rarely occur in buildings; apparently most roost in trees in summer. This species inhabits more caves in eastern North America than any other species of bat, usually hanging singly in warmer parts of the cave. An individual may occupy a precise spot in a cave on consecutive winters; it usually has several spots in which it hangs, shifting from one to another during the winter. This bat emerges from its daytime retreat early in the evening. The tri-colored bat is a weak flier and so small that it may be mistaken for a large moth. Tri-colored bats usually are solitary, although occasionally in late summer four or five will appear about a single tree. Flight is erratic and the foraging area is small. It often forages over waterways and forest edges. Tri-colored bats eat moths, beetles, mosquitoes, true bugs, ants, and other insects. Mating occurs in autumn; sperm are stored during winter; fertilization takes place in spring. These bats usually bear twins in late spring or early summer. Babies are born hairless and pink, with eyes closed. A baby is capable of making clicking sounds that may help its mother locate it. Tri-colored bats grow rapidly and can fly within a month. It is common throughout its range.

RAFINESQUE'S BIG-EARED BAT

Corynorhinus rafinesquii
Special Concern–United States

Weight is 8–14 grams (0.3–0.5 ounce); wingspan is 26–30 centimeters (10–12 inches); distribution is the southeastern United States. Rafinesque's big-eared bats occur in nearly every type of forested habitat within their range. Roosts include partially lighted, abandoned buildings, hand-dug wells, cisterns, grain silos, attics of occupied houses, highway culverts, bridges, and other human-made structures. They also roost in caves, trees, and other natural places. Maternity colonies usually are in abandoned buildings, sometimes in rather well-lighted areas, and consist of a few to several dozen adults. Maternity colonies are more rarely in caves and mines. Males generally are solitary during summer, roosting in buildings or hollow trees. When approached in summer, these bats begin to wave their ears, apparently trying to keep track of the intruder. This species and the tri-colored bat (*Perimyotis subflavus*) choose more open and more lighted day roosts than other kinds of bats. Both species commonly hang in the open in plain sight. Rafinesque's big-eared bat emerges late in the evening to forage; apparently it does not forage at twilight. Its flight is remarkably agile. Moths and other night-flying insects are eaten. One baby is born in late May or early June in the northern part of the range and about mid-May in the South. The young shed their milk teeth in mid-July and reach adult size by August or early September. Rafinesque's big-eared bat is uncommon over most of its range and has been proposed for listing as threatened or endangered.

TOWNSEND'S BIG-EARED BAT

Corynorhinus townsendii

C. t. virginianus and *C. t. ingens,* Endangered–United States

C. t. pallescens and *C. t. townsendii,* Special Concern–United States

Weight is 8–14 grams (0.3–0.5 ounce); wingspan is 30–32 centimeters (12–13 inches). Distribution includes western Canada, the western United States to southern Mexico, and a few isolated populations in the eastern United States. These bats hibernate in caves or mines where the temperature is 12°C (54°F) or less, but usually above freezing. Hibernation sites in caves often are near entrances in well-ventilated areas. If temperatures near entrances become extreme, they move to more thermally stable parts of the cave. Townsend's big-eared bats hibernate in clusters of a few to more than 100 individuals. During hibernation, the long ears may be erect or coiled. Solitary bats sometimes hang by only one foot. Maternity colonies usually are in relatively warm parts of the cave. During the maternity period, males apparently are solitary. Where most males spend summer is unknown. No long-distance migrations are known. Like many other bats, Townsend's big-eared bats return year after year to the same roost sites. It is believed to feed almost entirely on moths. Mating begins in autumn and continues into winter; sperm are stored during winter and fertilization occurs shortly after arousal from hibernation. One baby is born in June. Babies are large at birth, weighing nearly 25% as much as their mother. They can fly in 2.5–3 weeks and are weaned by 6 weeks. Lifespan may be 16 years or more. Subspecies in the eastern United States, *C. t. virginianus* (Virginia big-eared bat) and *C. t. ingens* (Ozark big-eared bat) are considered endangered. Two western subspecies, *C. t. townsendii* (Townsend's big-eared bat) and *C. t. pallescens* (western big-eared bat) have been proposed for listing as threatened or endangered.

SPOTTED BAT

Euderma maculatum

Special Concern–United States and Canada

Weight is 16–20 grams (0.6–0.7 ounce); wingspan is 34–36 centimeters (13–14 inches); distribution is from south-central British Columbia to southern Mexico. This spectacularly colored bat is white underneath and has black fur on its back with three large white spots. The spotted bat occurs in a wide range of habitats in the western regions of the continent, most often in rough, rocky, semiarid, or arid terrain, varying from ponderosa pine forest to scrub country and open desert. The day roosts often are situated on high cliffs. These bats crawl with ease on both horizontal and vertical surfaces, which facilitates their movement in rock crevices where they roost. Spotted bats emerge about an hour after dark and return to the day roost about an hour before sunrise. They fly high, usually 10–15 meters (30–50 feet), at or above treetop height, and have a loud high-pitched echolocation call that is clearly audible to the human observer at distances of about 250 meters (800 feet) or more. Spotted bats may use a foraging strategy that involves hunting a regular circuit and searching clearings in pine forests for prey. These bats display a remarkable punctuality in making their rounds, arriving at various points along their route at the same time every night. In spring, they spend 3–5 minutes at each clearing; more time is spent around the same area in summer. Diet consists primarily of moths. One baby is born in June. When born, babies lack the color pattern of adults; they weigh about 4 grams (0.1 ounce). One of the rarest bats in North America, it has been proposed for listing as threatened or endangered.

ALLEN'S BIG-EARED BAT

Idionycteris phyllotis

Special Concern–United States

Weight is 8-16 grams (0.3–0.6 ounce); wingspan is 31–35 centimeters (12–14 inches); distribution is the southwestern United States to central Mexico. This is a rather large bat with enormous ears and a unique pair of lappets projecting from the median bases of the ears over the top of the snout. When this bat is at rest, the huge ears lie along the back, often curled into the shape of a ram's horn. Allen's big-eared bat usually inhabits forested areas of the mountainous Southwest and is relatively common in pine-oak forested canyons and coniferous forests. It may also occur in nonforested, arid habitats. At most sites where this species occurs, cliffs, outcroppings, boulder piles, or lava flows are nearby. Day roosts may include rock shelters, caves, and mines. It leaves the roost only after complete darkness and usually flies about 10 meters (30 feet) above the ground. It emits loud calls at about 1-second intervals. Flight is slower than that of the free-tailed bats but swifter than most other bats. In close quarters, this species flies slowly, is highly maneuverable, is able to hover, and can fly vertically. In more open situations, it uses fast, direct flight. The sexes segregate geographically during summer, with females gathering into maternity colonies and males possibly remaining solitary, roosting elsewhere. Seasonal movements and winter whereabouts and activities are unknown. Allen's big-eared bat primarily consumes small moths, but soldier beetles, dung beetles, leaf beetles, roaches, and flying ants also are eaten. One baby is born in June or July. Locally common, but rare over most of its range, it has been proposed for listing as threatened or endangered.

PALLID BAT

Antrozous pallidus

Threatened–Canada

Weight is 20–35 grams (0.7–1.2 ounces); wingspan is 37–39 centimeters (15 inches); distribution is south-central British Columbia to central Mexico. It is common in arid regions with rocky outcroppings, particularly near water. This gregarious species usually roosts in small colonies of 20 or more individuals in rock crevices and buildings, but occasionally it roosts in caves, mines, piles of rocks, or tree cavities. Relative to other bats, pallid bats emerge from roosts relatively late; the time of evening emergence varies seasonally. Mothers and offspring may emerge and forage together. Pallid bats walk on the ground with a variety of strides and gaits, and they can hover or glide for short distances. They feed chiefly on large prey (2–7 centimeters [1–3 inches] in length) that is taken on the ground or, less frequently, in flight within a few meters of the ground or from the surfaces of vegetation. Prey items include flightless arthropods such as scorpions, crickets, and solpugids; ground-roving insects such as darkling ground beetles, scarab beetles, predacious ground beetles, carrion beetles, and short-horned grasshoppers; and prey gleaned from vegetation, including cicadas, katydids, praying mantises, long-horned beetles, and sphingid moths. Pallid bats also may eat lizards and rodents. One or two babies are born in May or June. Females hang upright during parturition, and newborns are held in the curled interfemoral membrane. This is a common species throughout most of its range.

SILVER-HAIRED BAT

Lasionycteris noctivagans

Weight is 8–11 grams (0.3–0.4 ounce); wingspan is 27–31 centimeters (11–12 inches); distribution is southern Alaska across southern Canada and southward through much of the United States to northeastern Mexico. A typical day roost is under loose tree bark, but these bats also have been found in woodpecker holes and bird nests. Although they may appear in any kind of building, they favor open sheds, garages, and outbuildings rather than enclosed attics. During migration, they may be encountered in a variety of other shelters including piles of railroad ties, lumber, and fenceposts. Silver-haired bats are rather common locally in migration during a 2–3-week period in May (Illinois) and in April (Kentucky and Tennessee). Autumn migration is spread over a longer period and these bats seem less common. They hibernate in trees, buildings, rock crevices, and similar protected shelters. This species emerges earlier than most. Easily recognizable in flight, it is one of the slowest flying bats in North America. It forages over woodland ponds and streams at heights up to 7–8 meters (20–25 feet) and sometimes flies repeatedly over the same circuit during the evening. Silver-haired bats consume insects including moths, true bugs, flies, mosquitoes, termites, and beetles. Young apparently are raised in the northern tier of states and northward into Canada. Most females give birth to twins in June or early July. This bat is relatively uncommon throughout much of its range, especially in the southeastern United States.

SOUTHWESTERN BAT (Southwestern Myotis)

Myotis auriculus

Weight is 5–8 grams (0.2–0.3 ounce); wingspan is 26–28 centimeters (10–11 inches). Distribution is from Arizona and New Mexico to southern Mexico, but the winter range is unknown. The southwestern bat often occurs in ponderosa pine forests. It is also present from mesquite and chaparral through the oak forests into pinyon-juniper habitats and seems to reach its greatest abundance in areas of extensive rocky cliffs where water is available. No day roosts are known; night roosts include buildings, mines, and caves. Migrations may result in selection of different habitats during different seasons. This species is most active 1.5–2.0 hours after sunset but may show other peaks of activity during the night. Flight speed is about 13 kilometers per hour (8 miles per hour). Moths are the primary food; males eat significantly more moths than females. This species is known to glean insects, primarily moths with 3- to 4-centimeter (1- to 2-inch) wingspans, from buildings and tree trunks; it may land briefly on the substrate, then pick the insect off the surface. One baby usually is born in June or early July, but timing of birth shows considerable geographic variation. Life span is at least 3 years. The southwestern bat is common throughout its range.

SOUTHEASTERN BAT (Southeastern Myotis)

Myotis austroriparius

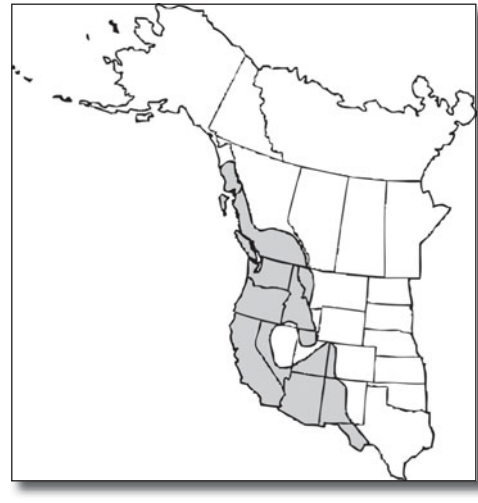
Special Concern–United States

Weight is 5–8 grams (0.2–0.3 ounce); wingspan is 24–27 centimeters (9–11 inches). Distribution includes the southeastern United States from southern Illinois and Indiana to northeastern Texas and northern Florida. Caves are favorite roosting sites, although buildings and other shelters sometimes are used. Maternity colonies composed of thousands of individuals inhabit caves. Throughout much of the South, these bats reside in buildings and hollow trees; in the northern part of their range they roost primarily in caves. In autumn, they leave large maternity caves, and small groups of these bats take up residence in caves and outdoor sites where they overwinter. Predators include Virginia opossums, snakes, and owls. By destroying roosting sites and killing these bats, humans are the major threat to the species. Southeastern bats usually are associated with bodies of water, over which they feed. They forage low, close to the water's surface. A variety of insects is consumed, but the diet of this species has not been studied. Mating time is unknown, but about 90% of pregnant females bear twins in late April or mid-May. Production of twins is unique among bats of the genus *Myotis* in the United States; all other *Myotis* generally produce only one baby. Clusters of babies often are separate from adult females during the day. Young bats can fly when 5–6 weeks old. Once common, populations of the southeastern bat have decreased significantly; it has been proposed for listing as threatened or endangered.

CALIFORNIA BAT (California Myotis)

Myotis californicus

Weight is 3–5 grams (0.1–0.2 ounce); wingspan is 22–23 centimeters (9 inches); distribution is from southern Alaska and western Canada southward through most of Mexico. It is one of the smallest bats in the United States. It occupies a variety of habitats in the Pacific Northwest and southern and western British Columbia, from the humid coastal forest to semidesert, and from sea level to about 1,800 meters (5,900 feet) elevation. In arid regions, it usually occurs in the vicinity of water. Individuals emerge shortly after sunset to forage, which continues at irregular intervals until dawn. Its flight is slow and erratic, and it hunts primarily along margins of tree clumps, around the edge of the tree canopy, over water, and well above the ground in open country. California bats roost in rock crevices, hollow trees, spaces under loose bark, and in buildings. The sexes roost separately during summer, when females form small maternity colonies, but occur together during September to March. They hibernate in caves and mines. The California bat feeds on small flying insects, primarily flies, moths, and beetles. Its foraging strategy consists of locating concentrations of insects where its slow maneuverable flight allows it to capture several insects in quick succession over a short distance. Breeding takes place in autumn and one baby is born in July. Lifespan is about 15 years. The California bat is common throughout its range.



WESTERN SMALL-FOOTED BAT (Western Small-footed Myotis)
Myotis ciliolabrum
Special Concern–United States

Weight is 4–6 grams (0.1–0.2 ounce); wingspan is 21–25 centimeters (8–9 inches); distribution is from southern Alberta and Saskatchewan to northeastern New Mexico and western Kansas. The western small-footed bat is yellowish on its back and nearly white on its underside. (The dark-nosed small-footed bat [*Myotis melanorhinus*] has a deeper yellowish color with a brownish underside.) In Alberta, the western small-footed bat is common along wooded waterways in rough terrain and in grassland habitats; in Nebraska, it occurs in deciduous and coniferous forests. Individuals or small colonies of 2–6 bats roost in rock crevices, erosion crevices in soil, stream banks, caves, tunnels, buildings, and under loose bark of trees. These bats forage over both natural water courses and man-made water holes. They dip to the surface to drink and feed on a variety of flying insects, including moths, flies, true bugs, and beetles. They chew their food to a fine degree. One baby, or occasionally twins, is born each year in May or June; lactation continues into late July. Ectoparasites are uncommon, but chiggers sometimes occur. Internal parasites include nematodes. The western small-footed bat has been proposed for listing as threatened or endangered.

LONG-EARED BAT (Long-eared Myotis)

Myotis evotis

Special Concern–United States

Weight is 5-8 grams (0.2–0.3 ounce); wingspan is 25–29 centimeters (10–11 inches); distribution includes southwestern Canada, western United States, and Baja California, Mexico. It occurs in a variety of habitats over its range in North America, but mostly in forested areas. In the Pacific Northwest and British Columbia, it occurs from dry forest to subalpine forest, especially where broken rock outcroppings prevail. Where suitable roosting sites are available, this species also is in semiarid shrubland, sage, chaparral, and agricultural areas. Females form small maternity colonies in summer, whereas males and nonpregnant females live singly or in small groups, occasionally occupying the same site as a maternity colony but roosting apart from it. Groups of 12–30 individuals have been found in roosts. Daytime roosts include abandoned buildings, hollow trees, loose slabs of bark, timbers of unused railroad trestles, caves and mines, fissures of cliffs, and sinkholes. This species emerges at dusk, and its flight is slow and maneuverable as it forages between and within the treetops and over woodland ponds. Predators include snakes, raccoons, hawks, and owls. Foods include moths, beetles, flies, net-winged insects, and true bugs. Males eat significantly more moths than do females. One baby is born in late June or early July. The long-eared bat has a recorded lifespan of 22 years. This species has been proposed for listing as threatened or endangered.

GRAY BAT (Gray Myotis)
Myotis grisescens
Endangered–United States

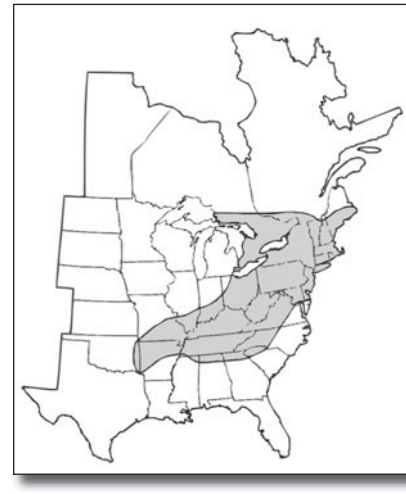
Weight is 8-11 grams (0.3–0.4 ounce); wingspan is 27–30 centimeters (11–12 inches). Distribution includes cave regions of Arkansas, Missouri, Kentucky, Tennessee, and Alabama, with occasional colonies in adjacent states. Gray bats are cave residents year-round, but different caves usually are occupied in summer and winter. Few have been found roosting outside of caves. They hibernate primarily in deep vertical caves with large rooms acting as cold-air traps (5–11°C [42–52°F]). In summer, females form maternity colonies of a few hundred to many thousands of individuals, often in large caves containing streams. Maternity colonies occur in caves that trap warm air (14–25°C [58–77°F]) or provide restricted rooms or domed ceilings capable of trapping combined body heat from clustered individuals. Because of gray bats' specific habitat requirements, fewer than 5% of available caves are suitable for them. Males and nonreproductive females form bachelor colonies in summer. Gray bats primarily forage over water of rivers and lakes. Moths, beetles, flies, mosquitoes, and mayflies are important in the diet, but gray bats also consume a variety of other insects. Mating occurs in September and October, and females enter hibernation immediately after mating, followed by males. Females store sperm through winter and become pregnant after emerging from hibernation. One baby is born in late May or early June; it begins to fly within 20–25 days of birth. Lifespan may exceed 14–15 years. Listed as endangered, about 95% of these bats hibernate in only about 15 caves, making them extremely vulnerable to destruction by humans or from natural catastrophic events. During recent years, numerous roost caves have been gated, resulting in population increases throughout most of this bat's geographic range. If this trend continues and if it is not decimated by white-nose syndrome, the species will likely be downlisted from endangered to threatened.

KEEN'S BAT (Keen's Myotis)
Myotis keenii
Special Concern–United States

Weight is 4–6 grams (0.1–0.2 ounce); wingspan is 21–26 centimeters (8–10 inches); The geographic range of Keen's bat is among the smallest of any bat in North America. The bulk of its range is in British Columbia west of the coastal mountains, extending into southeastern Alaska and northwestern Washington. Keen's bat is restricted to the dense coastal forest of the Pacific coast. The species is believed to be solitary and to roost in tree cavities and rock crevices. It hunts high along forest edges and over ponds and clearings, flying rather slowly. As in many other species of bats, abrupt directional shifts are achieved by extending and turning the broad side of the flight membrane of the wing in the direction of the turn, while the other wing performs a power stroke. Such turns can be executed very rapidly (1/16th of a second). Gentler turns are produced by a reduction of the braking effect on the side of the turn. Landing is achieved by using the flight membranes to brake. Aside from their primary function in flight, the wings and tail membrane may be used in capturing insects. Keen's bat consumes small flying insects. One baby is born in June or July. Status of populations is unknown, but this species probably is relatively uncommon.

EASTERN SMALL-FOOTED BAT (Eastern Small-footed Myotis)
Myotis leibii
Special Concern–United States

Weight is 3–4 grams (0.1 ounce); wingspan is 21–25 centimeters (8–10 inches); distribution is from eastern Canada and New England southward to Alabama and Georgia and westward to Oklahoma. This is one of the smallest bats in the United States and Canada. Eastern small-footed bats hibernate in caves or mines and are among the hardiest of cave bats. They are one of the last to enter caves in autumn and often hibernate near entrances of caves or mines where temperatures drop below freezing and where humidity is relatively low. Several have been found hibernating in cracks in cave floors and under rock slabs in quarries and elsewhere. The tolerance for cold, relatively dry places for hibernation is remarkable for such a small bat. In summer, they often inhabit buildings and caves. One small summer colony was behind a sliding door of a barn, and individuals may roost in rock crevices or expansion joints of bridges. They often fly repeated patterns within less than 1 meter (3 feet) of the floor of a cave or crevice, hang up on the wall, and then fly again. These bats emerge to forage shortly after sunset; they fly slowly and erratically, usually 1–3 meters (3–10 feet) above the ground. Apparently these bats fill their stomachs within an hour after foraging begins in the evening. They consume flies, mosquitoes, true bugs, beetles, ants, and other insects. One baby is born in late spring or early summer. Nursery colonies of up to 20 bats have been reported from buildings. Lifespan is unknown, but may be more than 9 years. The eastern small-footed bat is uncommon throughout most of its range and has been proposed for listing as threatened or endangered.



LITTLE BROWN BAT (Little Brown Myotis)

Myotis lucifugus

Weight is 7–14 grams (0.2–0.5 ounce); wingspan is 22–27 centimeters (9–11 inches). The species is widely distributed from central Alaska and southern Canada into the southwestern and southeastern United States. The little brown bat usually hibernates in caves and mines. During summer, it often inhabits buildings, usually rather hot attics, where females form nursery colonies of hundreds or even thousands of individuals. Where most males spend summer is unknown, but they likely are solitary and scattered in a variety of roost types. Colonies usually are close to a lake or stream. This species seems to prefer foraging over water, but it also forages among trees in rather open areas. When foraging, it may repeat a set hunting pattern around houses or trees. It eats insects, including gnats, crane flies, beetles, wasps, and moths. Insects usually are captured with a wing tip, immediately transferred into a scoop formed by the forward curled tail and interfemoral membrane, and then grasped with the teeth. Mating generally occurs in autumn but also may occur during hibernation. One baby is born in May, June, or early July. When the mother is at rest during the day, she keeps the baby beneath a wing. Lifespan may be more than 30 years. The little brown bat is one of the most common bats throughout much of the northern United States and Canada; it is scarce or only locally common in the southern part of its range. Northern populations have been severely impacted by white-nose syndrome, which is predicted to reduce some populations to near extinction. It appears likely that the little brown bat will be proposed for listing as threatened or endangered.

DARK-NOSED SMALL-FOOTED BAT (Dark-nosed Small-footed Myotis)
Myotis melanorhinus
Special Concern–United States

Weight is about 4–5 grams (0.1–0.2 ounce); wingspan is 24–25 centimeters (9–10 inches); distribution is from southern British Columbia to central Mexico. The dark-nosed small-footed bat seems to prefer arid habitats, where it is associated with cliffs and talus fields; on prairies it is associated with clay buttes and steep riverbanks. This species roosts in crevices in rock faces and clay banks, may use spaces beneath and between boulders in talus fields, and also has been found roosting beneath bark and in barns. The dark-nosed small-footed bat begins its nightly activity shortly after sunset with peaks of activity between 10:00 and 11:00 p.m. and 1:00 and 2:00 a.m. It flies slowly and erratically as it forages at heights of 1–3 meters (3–10 feet) along cliffs and rocky slopes. It may forage over water when not in association with the California bat (*Myotis californicus*), which usually hunts over and near water. In British Columbia, the proportions of different species of prey taken by the dark-nosed small-footed bat and the California bat are similar. It appears that these species coexist by spatial partitioning of the available food resource. Hibernation sites include caves and mines. Foods consist of small insects such as flies, beetles, and moths. One baby is usually born in June, but twins also occur. The dark-nosed small-footed bat has been proposed for listing as threatened or endangered.

ARIZONA BAT (Arizona Myotis)
Myotis occultus
Special Concern–United States

Weight 7–9 grams (0.2–0.3 ounce), wingspan 24–25 centimeters (9–10 inches). The species occurs only in the southwestern United States and Mexico. Habitat is variable, from ponderosa pine and oak-pine woodlands near water, to areas with permanent water in riparian forest, to desert areas along rivers. Mines rarely are used in summer, but may be used in winter. It spends daytime hours in crevices in canyon walls, caves, attics, and other safe shelters, emerging shortly before dark. Diet in New Mexico is soft-bodied insects such as wasps and midges. In Colorado, diet is hard-bodied insects, including bark beetles and click beetles, which are economically important pests. Lactating females tend to capture larger prey. Foraging occurs under large cottonwood trees and in orchards at low elevations. At higher elevations, foraging usually is at a low level over and around water. This species can consume 600 mosquitoes per hour. Apparently, the sexes occupy separate roosts in summer. Maternity colonies of 60–800 females have been found in dead ponderosa pines, in buildings near permanent water, and in crevices between timbers of a highway bridge that has since been destroyed. One young is born each year in late June. Of the four known maternity roosts, two have been destroyed; one colony was at least partially excluded from the building it occupied; and the status of the fourth is unknown. Forest-harvesting practices, pesticides, and disturbance of colonies in summer and winter are threats to the Arizona bat.

NORTHERN LONG-EARED BAT (Northern Myotis)

Myotis septentrionalis

Weight is 6–9 grams (0.2–0.3 ounce); wingspan is 23–26 centimeters (9–10 inches); and distribution includes southern Canada and the central and eastern United States southward to northern Florida. Northern long-eared bats hibernate in parts of caves and mines that are relatively cool and moist, where the air is still. Hibernation may begin as early as August and may last for 8–9 months in northern latitudes. In summer, these bats roost by day in a variety of shelters, including inside buildings and under tree bark and shutters. At night they commonly use caves as night roosts. Northern long-eared bats seem much more solitary in their habits than other members of the genus *Myotis,* and they generally are found singly or in small groups containing fewer than 100 individuals. Although they frequently hang in the open, they seem to prefer tight crevices and holes. Sometimes only the nose and ears are visible; they can be distinguished from most other species of *Myotis* by their long ears. These bats forage mainly on forested hillsides and ridges rather than in streamside and floodplain forest. They consume a variety of small night-flying insects. Presumably, most mating occurs in autumn prior to hibernation. Apparently, small nursery colonies are formed in June and July where pregnant females give birth to one baby. Mothers may be able to retrieve their young that fall from roost sites. Lifespan may be more than 18 years. The northern long-eared bat is common over much of its range.

INDIANA BAT (Indiana Myotis)

Myotis sodalis

Endangered–United States

Weight is 7–8 grams (0.2–0.3 ounce); wingspan is 24–27 centimeters (9–11 inches). Its distribution includes cave regions in the eastern United States. Indiana bats usually hibernate in large dense clusters of up to several thousand individuals in sections of the hibernation cave where temperatures average 3–6°C (38–43°F), with a relative humidity of 66%–95%. They may hibernate from October to April, depending on climatic conditions. Females depart hibernation caves before males and arrive at summer maternity roosts in mid-May. The summer roost of adult males often is near maternity roosts, but where most males spend the day is unknown. Some remain near the hibernaculum, and a few males are in caves during summer. Between early August and mid-September, Indiana bats arrive near their hibernation caves and engage in swarming and mating activity. Swarming at cave openings continues into middle or late October. During this time, fat reserves are built up for hibernation. When pregnant, females consume soft-bodied insects; they eat moths when lactating, and moths, beetles, and hard-bodied insects after lactation. Males also eat a variety of insects. One baby is born in June and is raised under loose tree bark, primarily in wooded streamside habitat. Life spans of nearly 14 years have been documented. In 2009, total population of this endangered species was about 387,500, with more than 85% hibernating at only 15 locations, making them extremely vulnerable to destruction by humans or from natural catastrophic events. Populations have increased during recent years. However, more recently, hundreds of thousands of Indiana bats, as well as other cave-dwelling species of bats in the eastern United States, have died due to a disease known as white-nose syndrome.

FRINGED BAT (Fringed Myotis)

Myotis thysanodes

Special Concern–United States

Weight is 5–7 grams (0.2–0.3 ounce); wingspan is 27–30 centimeters (11–12 inches); distribution includes southern British Columbia, Canada, western United States, and most of Mexico. The fringed bat occurs in a variety of habitats from desert-scrub to fir-pine associations. Oak and pinyon woodlands appear to be the most commonly used vegetative associations. Roost sites may be in caves, mines, or buildings. There are periodic changes in roost sites within a maternity roost because of thermoregulatory requirements of the bats; clusters of bats move in response to temperature changes in the roost. Fringed bats migrate, but little is known about the magnitude of their movements. Females prepare physiologically for hibernation during the postlactation period of late summer and early autumn, prior to migration. Individuals may awake from hibernation periodically throughout winter. Diet includes beetles and moths. These bats forage close to the vegetative canopy, and have relatively slow and highly maneuverable flight. Mating takes place in autumn. Ovulation, fertilization, and implantation occur in late April and early May, and one baby is born in late June or early July. Birth occurs in a head-down posture. After parturition, newborn bats are placed in a cluster separate from adults. Adults then fly to the cluster of newborn, suckle their baby, and return to their original roost site. The fringed bat has been proposed for listing as threatened or endangered.

CAVE BAT (Cave Myotis)

Myotis velifer

Special Concern–United States

Weight is 12–15 grams (0.4–0.5 ounce); wingspan is 28–32 centimeters (11–13 inches); distribution is southern Kansas and western Oklahoma, the southwestern United States, Mexico, and into Central America. This bat occurs in colonies of 2,000–5,000 individuals throughout much of its range. Habitats vary from desert floodplains and rocky canyons to the cave country from central Texas to south-central Kansas. In summer, this species congregates in caves, mines, and less often in buildings. Most individuals in populations in Arizona and California appear to be migratory, and most in Kansas, Oklahoma, and Texas appear to be permanent residents that hibernate in caves during winter. Flight is stronger, more direct, and with less flutter than most other bats of the genus. These bats begin emerging from the daytime roost well before dark, fill their stomachs within about half an hour of foraging, and retire at night to some shelter such as a building, cave, or mine for a resting period. There is no clearly defined second foraging period in early morning as in some other species. Predators include snakes, hawks, owls, and raccoons. Like many insectivorous bats, this species is opportunistic in feeding habits, with diets that fluctuate by season and habitat. Common food items are small moths and beetles. After a gestation of 60–70 days, one baby is born in late June or early July. During parturition (20 minutes), the baby is caught in the mother's folded tail membrane, and then it crawls to a nipple and begins to nurse. Lifespan may be 10–12 years. The cave bat has been proposed for listing as threatened or endangered.

LONG-LEGGED BAT (Long-legged Myotis)

Myotis volans

Special Concern–United States

Weight is 6–9 grams (0.2–0.3 ounce); wingspan is 25–27 centimeters (10–11 inches); distribution is southern Alaska and western Canada southward into northern Mexico. The long-legged bat primarily inhabits forested mountainous regions, where it roosts in trees, rock crevices, cracks and crevices in stream banks, and buildings. It may be in streamside and arid habitats in some areas. This bat emerges early in the evening when it is still twilight. It is a rapid, direct flier that pursues prey over relatively long distances through, around, and over the forest canopy. This species is active throughout most of the night, although there is a peak of activity in the first 3–4 hours after sunset. It is moderately gregarious in maternity colonies and during swarming in late summer and hibernation. Hibernation sites include caves and mine tunnels. There are usually more males than females at hibernation sites. The ability to fly at cool temperatures may enable this species to extend the prehibernation period of activity. The long-legged bat feeds primarily on moths, although it also consumes other, primarily soft-bodied, invertebrates, including flies, termites, lacewings, wasps, true bugs, leafhoppers, and small beetles. One baby is born in July. Maternity colonies may be in crevices in rocks, trees, stream banks, or in buildings. Lifespan may be up to 21 years. The long-legged bat has been proposed for listing as threatened or endangered.

YUMA BAT (Yuma Myotis)
Myotis yumanensis
Special Concern–United States

Weight is 4-6 grams (0.1–0.2 ounce); wingspan is 22–24 centimeters (9 inches); distribution is from southwestern British Columbia, through the western United States, and into central Mexico. From the cottonwood-lined streams of the southwestern deserts to the redwood canyons of the Pacific coast, nearly all habitats of the Yuma bat show a common feature, the presence of open water nearby. It often is in areas without trees. Although locally abundant, the species seems to be absent in many apparently suitable feeding areas. The Yuma bat emerges when it is nearly dark and forages just above the surface of streams and ponds. Night roosts often show little or no evidence of use, but careful searching of abandoned cabins, attics, porches, and similar sites usually will reveal guano. In late May and early June, large nursery colonies may form in buildings, caves, mines, or under bridges. As with many other bats, males take no part in care of the young and usually are not found near nursery roosts. Instead, adult males generally scatter and lead somewhat solitary lifestyles. Nursery roosts are quickly abandoned if disturbed. Nursery roosts are vacated in autumn, although the migration destination of the bats is unknown. Diet includes beetles and relatively soft-bodied insects such as flies, termites, moths, and mayflies. One baby is born in late May or in June. Females give birth for the first time in the summer following their own birth. The Yuma bat has been proposed for listing as threatened or endangered.

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HAIRY-LEGGED VAMPIRE BAT

Diphylla ecaudata
Accidental–United States

Weight is 24–43 grams (0.8–1.5 ounces); wingspan is 37–45 centimeters (15–18 inches). The species is known from only one record in the United States. In 1967, a hairy-legged vampire bat was observed in an abandoned railroad tunnel in Val Verde County, Texas. The species occurs across eastern Mexico to southern Brazil. It breeds in all seasons, usually producing a single young each year. At birth, the eyes are open and deciduous teeth are present. Habitats occupied are tropical and subtropical, with roosts nearly exclusively in caves and mines, rarely in hollow trees. It is solitary and does not form groups even when many individuals occupy the same cave. However, it may share food by mouth-to-mouth regurgitation. Of the three species of vampire bats, the hairy-legged vampire bat has the most specialized diet, consuming only blood of birds. When feeding on domestic chickens, these bats land on the back of the chicken, move to the posterior part of the bird, and bite the bird in the anal region or lower leg. Chickens seem to be relatively undisturbed by this, but may peck at the bats to remove them. The teeth of this vampire bat may be so sharp that its prey usually does not feel its bite, saliva of the bat may contain an anesthetic, or both. An anticoagulant helps keep the blood flowing; the tongue is grooved so that the bat ingests blood in a manner similar to sucking on a straw.

BUFFY FLOWER BAT

Erophylla sezekorni
Accidental–United States

Weight is 16–18 grams (0.6 ounce). There is a record of occurrence in the Florida Keys, and the species is present throughout most of the Greater Antilles and associated islands. Large colonies occupy cooler portions of hot (25–28°C [77–82°F]) caves from well-lighted areas near entrances to deep, dark chambers. Individuals may hang alone or in groups on walls or ceilings of caves. Diet includes fruits, pollen, nectar, and insects, especially beetles. As with other species with a similar diet, they have a long tongue with tiny fingerlike projections on it. This species has a lek mating system: a few males gather to display, emit odors, and vocalize to attract females for mating. The buffy flower bat is a seasonal breeder that produces one young each year. Young are born by breech presentation (i.e., the tail-end exits the birth canal first). At birth, young are about 25% as large as the mother. They are hairless; eyes are open; ears are partially erect; canines have erupted; and wing membranes are translucent. Females can easily fly with their attached young. Young become independent at about 2 months old. Buffy flower bats are intolerant of disturbance by humans and will abandon caves that are visited by humans. Puerto Rican boas are patient predators that hang from rock walls and other objects at cave openings and grab passing buffy flower bats as they exit or enter the cave.

CUBAN FLOWER BAT

Phyllonycteris poeyi
Accidental–United States

Weight is about 14 grams (0.5 ounce) and, other than a fossil from the Bahamas and a recent record in the Florida Keys, the species is known only from Cuba and Hispaniola. Pelage of the Cuban flower bat is grayish white; it has a silky texture and silvery reflections under certain light. The head is long and narrow, and the long tongue has many tiny papillae for gathering nectar. It occupies caves and sometimes forages by flying around crowns of trees in urban parks. It may make nightly commutes of 20 kilometers (12 miles) between roosts and foraging areas. Unlike other foraging bats of this family (Phyllostomidae), Cuban flower bats emit relatively long and intense echolocation calls when flying in open areas. However, in closed habitats, these bats emit short and low-intensity calls, as do other phyllostomid bats. In addition to eating nectar and pollen, Cuban flower bats also consume fruit and insects that they may catch at flowers. The species is quite gregarious, and 50,000 individuals have been reported in one cave in Cuba. Caves used as day roosts are humid and hot with temperatures of 28°–30°C (82°–86°F). Most young are born in June. These bats hang from walls and ceilings with their legs spread apart. They take flight immediately upon disturbance, and they fly high in centers of cave chambers. At cave openings, feral cats, Cuban boas, Cuban racers, and probably other snakes prey upon Cuban flower bats.

CUBAN FIG-EATING BAT

Phyllops falcatus

Accidental–United States

Weight is 16–23 grams (0.6–0.8 ounce); wingspan is 32–37 centimeters (13–15 inches). This species is known from the United States based on one record at Key West, Florida. The Cuban fig-eating bat is an uncommon species that occurs only in the Caribbean area, especially on the islands of Cuba and Hispaniola, where it occupies lowlands in a variety of forested habitats including evergreen, submontane, pine, and semideciduous forest. It also has been found in urban parks in Havana, Cuba, and Key West, Florida. Evidence derived from fossils indicates the species was once more limited in distribution and that it spread from Hispaniola to Cuba relatively recently. Distinct patches of white hair on each shoulder that extend to just behind the ears and a translucent membrane on the edge of the wing are distinguishing characteristics. The Cuban fig-eating bat roosts in hollow trees or in shadows of foliage of trees in clusters of up to five individuals. It has been known to occupy bat houses. It consumes fruits, figs, vegetative matter, and insects, but little else is known about its diet. When approaching bushes, trees, or fruits, its echolocation calls become shorter and faster that in open flight. Throughout Cuba, barn owls prey intensively on this species. Preliminary studies of its behavior indicate that Cuban fig-eating bats may form harems, as do the closely related Jamaican fruit-eating bats.

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SUMMARY

Bats are an extremely interesting and highly beneficial segment of our fauna. They should be understood and appreciated, not feared and persecuted. Like many wild animals, they sometimes pose public health problems or become nuisances by residing where they are not wanted. However, their benefit as the only major predator of night-flying insects greatly outweighs any negative aspects.

Although only seven kinds of bats in the United States and Canada (four entire species and three subspecies) are listed as endangered, most species seem to be steadily declining in number, some at a rapid rate. Disturbance of hibernating and maternity colonies by humans and the all too prevalent attitude that "the only good bat is a dead bat," have been important factors in declining populations of

Visitors at Carlsbad Caverns National Park, New Mexico, enjoy a presentation by a park naturalist as they await the spectacular out-flight of Mexican free-tailed bats (*Tadarida brasiliensis mexicana*). *Troy L. Best*

bats. Habitat destruction and use of pesticides and other chemical toxicants also have taken a heavy toll, not only on bats, but on many other fascinating and beneficial species as well.

The steady decline in the number of bats, as well as many other species, represents much more than a decrease in a population of organisms. It also reflects a steady decline in our overall quality of life.

The *wufu* symbol, the original logo of Bat Conservation International (BCI), was incorporated into its updated logo. The nonprofit organization is dedicated to conserving bats and their habitats around the world through scientific research, direct conservation, and public education about the value of bats. A wealth of information about bats is available on BCI's website (batcon .org) and in its quarterly magazine *BATS*. *Bat Conservation International*

APPENDIX

Bats of the United States and Canada
(Including Protection Status)

*Species occurring in both the United States and Canada.

FAMILY PHYLLOSTOMIDAE

Mexican Long-tongued Bat, *Choeronycteris mexicana* (SC-US)
Mexican Long-nosed Bat, *Leptonycteris nivalis* (END-US)
Lesser Long-nosed Bat, *Leptonycteris yerbabuenae* (END-US)
California Leaf-nosed Bat, *Macrotus californicus* (SC-US)
Jamaican Fruit-eating Bat, *Artibeus jamaicensis*

FAMILY MORMOOPIDAE

Peter's Ghost-faced Bat, *Mormoops megalophylla*

FAMILY MOLOSSIDAE

Florida Bonneted Bat, *Eumops floridanus* (SC-US)
Greater Bonneted Bat, *Eumops perotis*
  Western Bonneted Bat, *E. p. californicus* (SC-US)
Underwood's Bonneted Bat, *Eumops underwoodi* (SC-US)
Pallas' Mastiff Bat, *Molossus molossus*
Pocketed Free-tailed Bat, *Nyctinomops femorosaccus*
Big Free-tailed Bat, *Nyctinomops macrotis* (SC-US)
Brazilian Free-tailed Bat, *Tadarida brasiliensis*

FAMILY VESPERTILIONIDAE

*Big Brown Bat, *Eptesicus fuscus*
*Western Red Bat, *Lasiurus blossevillii*
*Eastern Red Bat, *Lasiurus borealis*

*Hoary Bat, *Lasiurus cinereus*
  Hawaiian Hoary Bat, *L. c. semotus* (END-US)
Southern Yellow Bat, *Lasiurus ega*
Northern Yellow Bat, *Lasiurus intermedius*
Seminole Bat, *Lasiurus seminolus*
Western Yellow Bat, *Lasiurus xanthinus*
Evening Bat, *Nycticeius humeralis*
Canyon Bat, *Parastrellus hesperus*
*Tri-colored Bat, *Perimyotis subflavus*
Rafinesque's Big-eared Bat, *Corynorhinus rafinesquii* (SC-US)
*Townsend's Big-eared Bat, *Corynorhinus townsendii*
  Virginia Big-eared Bat, *C. t. virginianus* (END-US)
  Ozark Big-eared Bat, *C. t. ingens* (END-US)
  Western Big-eared Bat, *C. t. pallescens* (SC-US)
  Townsend's Big-eared Bat, *C. t. townsendii* (SC-US)
*Spotted Bat, *Euderma maculatum* (SC-US; SC-CAN)
Allen's Big-eared Bat, *Idionycteris phyllotis* (SC-US)
*Pallid Bat, *Antrozous pallidus* (THR-CAN)
*Silver-haired Bat, *Lasionycteris noctivagans*
Southwestern Bat, *Myotis auriculus*
Southeastern Bat, *Myotis austroriparius* (SC-US)
*California Bat, *Myotis californicus*
*Western Small-footed Bat, *Myotis ciliolabrum* (SC-US)
*Long-eared Bat, *Myotis evotis* (SC-US)
Gray Bat, *Myotis grisescens* (END-US)
*Keen's Bat, *Myotis keenii* (SC-US; DD-CAN)
*Eastern Small-footed Bat, *Myotis leibii* (SC-US)
*Little Brown Bat, *Myotis lucifugus*
*Dark-nosed Small-footed Bat, *Myotis melanorhinus* (SC-US)
Arizona Bat, *Myotis occultus* (SC-US)
*Northern Long-eared Bat, *Myotis septentrionalis*
Indiana Bat, *Myotis sodalis* (END-US)
*Fringed Bat, *Myotis thysanodes* (SC-US; DD-CAN)
Cave Bat, *Myotis velifer* (SC-US)
*Long-legged Bat, *Myotis volans* (SC-US)
*Yuma Bat, *Myotis yumanensis* (SC-US)

Species of Accidental Occurrence

The following species of bats have been recorded as present in the United States. However, they are not considered to be permanent residents, and thus are referred to as "accidentals."

FAMILY PHYLLOSTOMIDAE

Hairy-legged Vampire Bat, *Diphylla ecaudata* (ACC-US)
Buffy Flower Bat, *Erophylla sezekorni* (ACC-US)
Cuban Flower Bat, *Phyllonycteris poeyi* (ACC-US)
Cuban Fig-eating Bat, *Phyllops falcatus* (ACC-US)

NOTE: ACC-US = accidental occurrence in the United States; DD = data deficient (Canada); END = endangered species or subspecies; SC = species or subspecies of special concern; THR = threatened species or subspecies.

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